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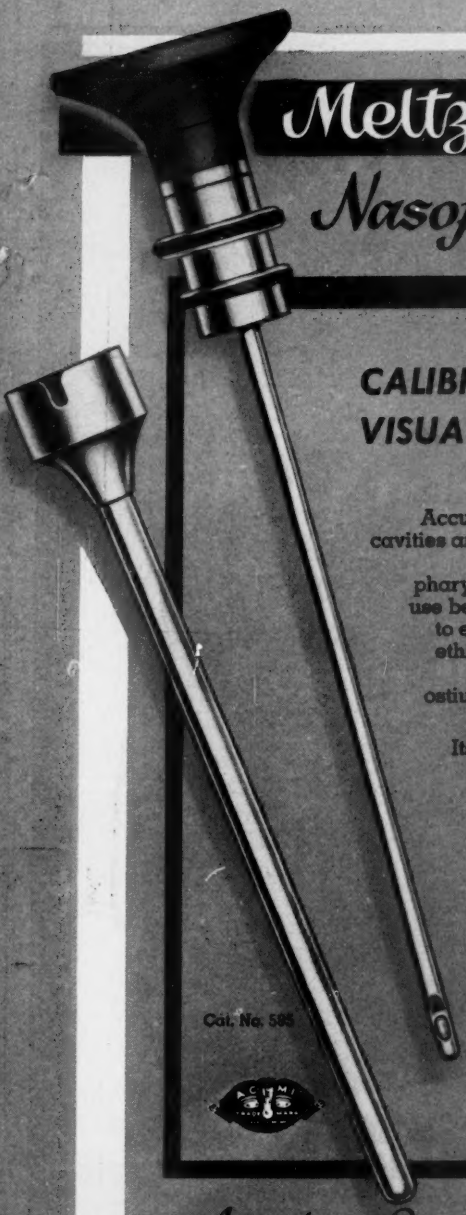

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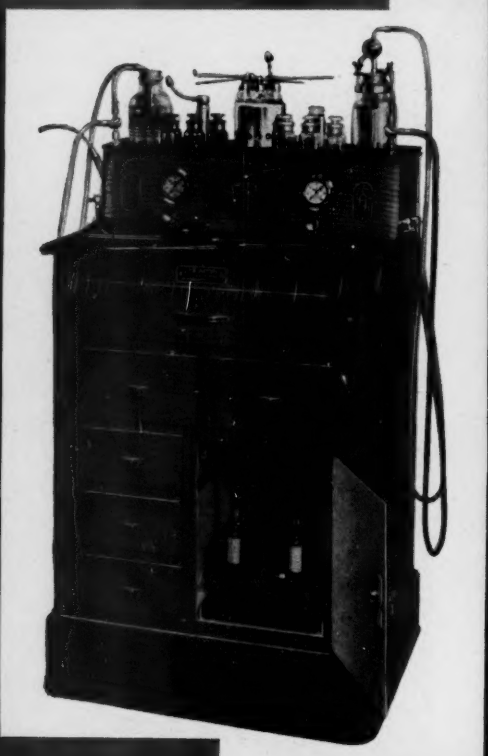

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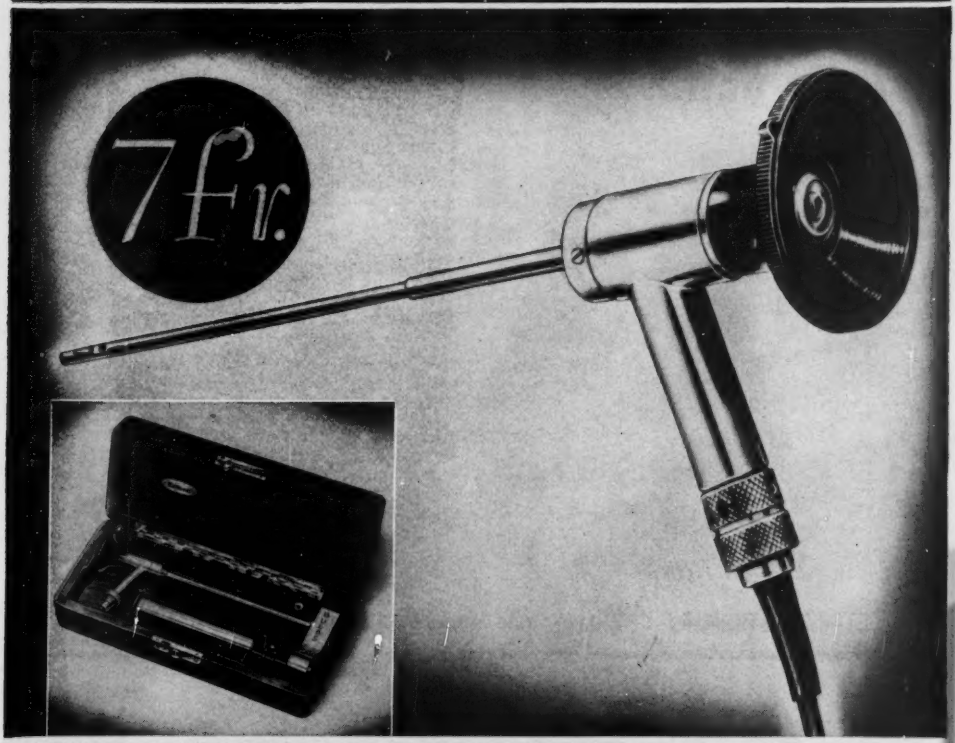

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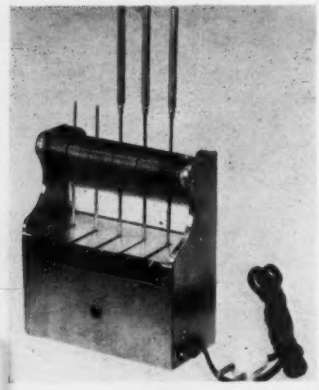

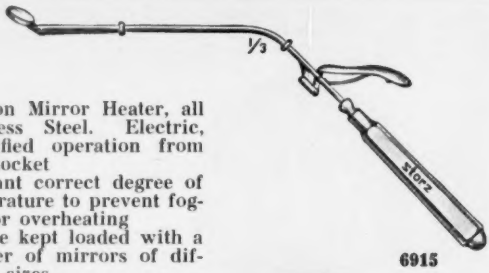

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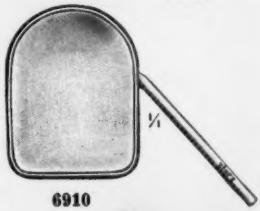

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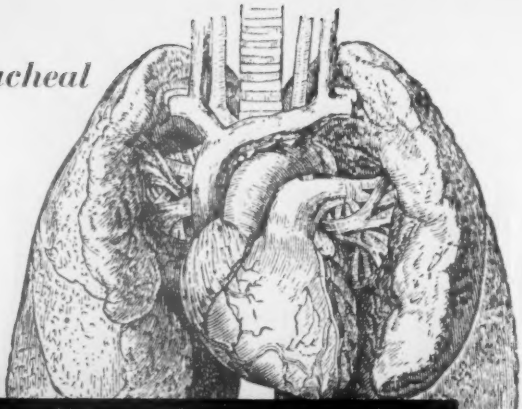

CASE	DIAGNOSIS	INFECTING ORGANISM	DAYS TREATED	TOTAL DOSE, GM.	ADMINISTRATION	CONDITION AND RESULT
16	Acute laryngotracheal bronchitis	Hemophilus Influenzae	3	12	oral	Marked improvement in 24 hours Recovery

Case report taken from Herrell, W. E.; Heilman, F. R., and Wellman, W. E.: Ann. New York Acad. Sc. 53:448 (Sept. 15) 1950.

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1. Welch, H.; Hendricks, F. D.: Price, C. W., and Randall, W. A.; J. A. Ph. A. (Sc. Ed.) 39:185 (Apr.) 1950.
2. Douglas, R. G.; Ball, T. L., and Davis, I. F.: California Med. 73:463 (Dec.) 1950.

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SIGNS, EMBLEMS AND SYMBOLS OF CHOICE IN PLOTTING THRESHOLD AUDIOGRAMS

EDMUND PRINCE FOWLER, M.D.
NEW YORK

A SIGN is a distinctive mark used in order that something may be recognized or that its presence may be known. The letters of the alphabet are signs of certain sounds. A sign once established actually suggests the thing it stands for, with or without reason, intention or choice.

An emblem has some natural fitness to suggest that for which it stands. (An emblem resembles in some respect the thing it stands for.)

A symbol is a term given to an object representing to the mind something that is not shown but that is realized by association. A symbol is a term chosen to suggest something else. (A symbol represents with or without natural fitness; letters are often used as symbols in the sciences.) A symbol may also be an emblem, and when such is the case it is doubly appropriate for the use in question, in the present case, in plotting the acuity of hearing. Symbols should not be chosen haphazardly or on the whim of the user, and once established the original use should be continued, unless better symbols are devised.

I shall briefly relate the history of the designing of the audiogram chart and the reasons for the choice of the symbols used for plotting the threshold audiogram curves. The plotting of overthreshold sounds will be discussed in a subsequent paper.

In 1920 and 1921, during the latter stages of the setting up and the manufacturing of a clinical audiometer in close consultation with Mr. R. L. Wegel and Dr. Harvey Fletcher, it was important to consider the plotting of the audiograms not only from the standpoint of the physicist but also, and maybe most importantly, from the viewpoint of the otologists, for whom the instrument was primarily designed.

Few clinicians at that date used even the term "threshold," and the unit of measure, the "decibel," was practically unknown to them. Moreover, the curved parabolic line that the physicists used to represent the threshold of hearing was and still is confusing to the clinician. The question was, how should one proceed? I believed that the instrument would be used more extensively if one used the technical language and technics involved, while at the same time always supplementing them with the otologists' then current and apparently more understandable terminology, as well as with the technical and more accurate terminology of the telephone physicists.

I proposed and insisted that in spite of the more factual representation of the average normal threshold intensities by the curved line, a straight base line should be used and that the chart should be inverted so that hearing losses would appear

below the threshold line and not above it, as is normal with engineering and physicist practice. In this way (hearing) losses would be charted below the average normal threshold line and not above it, as was customary with physicists.

These decisions provided a chart that the clinician could better visualize. Within a few years the otologist became accustomed to the term "decibel," so that "db" became a common word, and the term "sensation unit" was abandoned in favor of decibel (abbreviated db.).

Other questions to be decided were as follows: 1. Should the chart intensity scale represent sensation units or decibel loss or per cent loss at the different frequencies? 2. Should the intensity scale be represented arithmetically or logarithmically? 3. Should the frequency scale be represented in whole numbers, such as 50, 100, 200, 400, 800, 1000, or should it follow the common musical octave scale, i.e., 32, 64, 128, 256, 512, 1024, etc.? The arithmetical scale was impractical, because if the intervals were spaced sufficiently far apart for clear visibility it would require 24 times as much paper as the logarithmetic scale. Moreover, the ear is normally attuned to sense intensities as well as to frequencies logarithmically. Also, the musical scale seemed desirable because most tuning forks were made in the musical octave scales, because clinicians were accustomed to using these musical frequencies and because later, when everyone would become more familiar with audiometric measurements, the simpler frequency scale could be adopted.

Originally, between all the middle octaves, one third octave intervals were inserted, and one half octave intervals were inserted for the frequencies below 512 and above 4096, and audiometers even with continuous frequency scales were manufactured. When, clinically, it became apparent that seldom, except for research purposes, were these elaborate arrangements necessary, they were, and still are, generally omitted. As a matter of fact, except for the necessity of conforming to the then otological practice, the common musical octave scale would not have been used. We otologists wanted to encourage the use of the clinical audiometer by making it as simple as possible. Recently the American Medical Association's Council on Physical Medicine and Rehabilitation, on the advice of its Advisory Committee on Audiometers and Hearing Aids, has adopted the whole number scale. Those who own audiometers with the old musical scales will not be inconvenienced, because the change from 512 to 500 or 2048 to 2000, etc., implies a change of only about 2.5 per cent. This 2.5 per cent difference is smaller than the intensity and frequency tolerance standards now set up for acceptable audiometers, so that the old settings on the dial may be supplanted by the even numbers without fear of error.

Now to consider the symbols of choice for plotting the right ear and the left ear by air and by bone conduction. In considering the ear diagrammatically, as children do in their simple drawings, the auditory canal is represented crudely by a dot (.) or a circle (o). (Both the dot and the circle represent openings, in this case the external auditory canals.) These are the only symbols that can be used without overlapping when they are used over a single point, such as ⊙. Such indications as cross marks (x), triangles (△) and letters (a, b, c) were not suitable for several reasons, and so, after some experimenting, I chose the dot (.) as the symbol to represent the right ear and the circle (o) to represent the left ear. These symbols are easy to remember because "dot" suggests dextra and "circle" phonetically at

least, suggests sinistra. Other symbols are wholly arbitrary and do not bring before the mind any suggestive resemblance or association with the things they represent.

Examine figure 1 and see how confusing symbols may be, especially where lines are drawn through them to represent the hearing threshold curves, and more especially when bone conduction is added. Note that the triangles (as well as crosses) are apt to blot or blur and that they occupy more space than circles.

I chose a square to represent the losses by bone conduction when these losses were equal (not necessarily because of the possible suggestion of "square head" or "block head"). Clinicians regularly use outline drawings of the human body, and because, as the picture faces them, the left side of the drawing represents the right side of the body and the right side of the drawing, the left (head) and its areas, a bracket ([) is used to the left of the frequency ordinate for the right ear and an opposing bracket (]) to the right of the frequency ordinate for the left ear. These symbols fit nicely around the dot and the circle without overlapping and even without touching each other when all plotted points for a given frequency are identical for air conduction and bone conduction, thus [⊙]. No other symbols are capable of

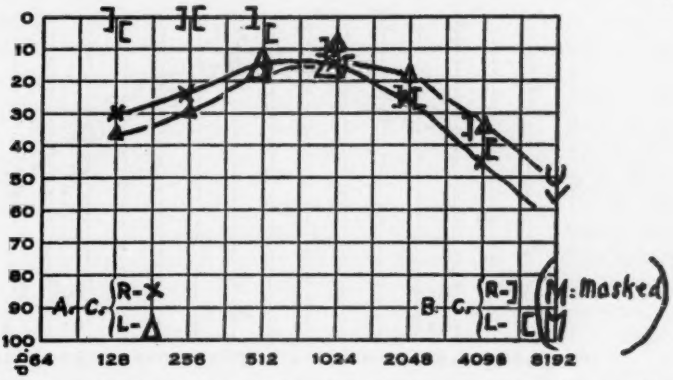

Fig. 1.—Objectionable and confusing symbols used in charting threshold audiograms. If x is used for one ear and + for the other, or if △ is used for one ear and ▷ for the other, or if o is used for one ear and x for the other, the confusion will be more confounded. Try these symbols on your charts and prove it.

doing this unless they are drawn by an expert draftsman or are made to extend far beyond the plotted point, in which case they tend to spread over too much space and confuse the observer. Could anything be more logical, clear and simple than the suggested use?

Now look at figure 2 and see how clear all plotted points appear. It is my custom not to join the plotted points in my own audiograms, but for lantern slides and certain publications lines are used when advisable. When lines are used a solid line should indicate the right ear and a broken line the left. The reason should be obvious. The solid line joins the dots without distorting the picture. The broken line is not drawn through the plotted points and therefore does not mess up any of the symbols.

If colors are used, red (suggesting right) should be used for the right ear and some other color, say lemon or lead (suggesting left), for the left ear. Blue also

may be used appropriately for the left ear since the word blue prominently contains the letter "l," suggesting left. It is undesirable to draw lines to represent the bone conduction; doing so diverts attention from the air conduction curves and thresholds, besides, too many lines are confusing, particularly if they coincide or run near one another.

The audiogram chart should be kept simple; therefore, when masking sounds are used, their intensity and frequency should be noted in decibels below the thresholds along the ordinate of the frequency being masked or below the chart. When so-called "white noise" or "thermal noise" is used for masking, the intensity used should be written either on the lower portion or below the bottom of the chart.

There is much confusion and misunderstanding concerning masking. It is not generally understood that an air conduction masking sound above 35 to 50 decibels, depending on frequency, is loud enough to be sensed by the contralateral ear (at its threshold or above) if the bone conduction in this contralateral ear is not sufficiently depressed to prevent it. Such a masking sound will therefore diminish the hearing in the opposite ear. This diminution will occur whether the hearing in the tested

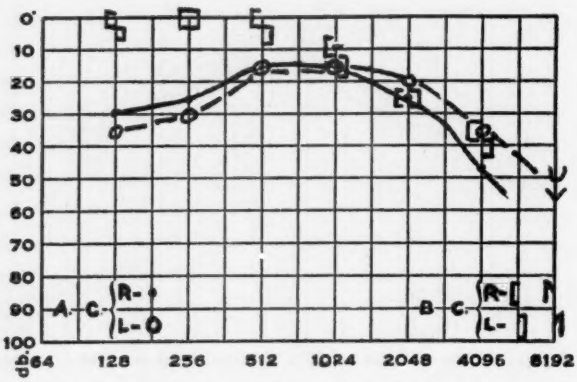

Fig. 2.—Preferred and clear symbols used to chart threshold audiograms. If the dots are obliterated by the solid line it does not matter as it does when other symbols are used. The dot becomes incorporated into the solid line without blurring. The line itself then marks the thresholds.

ear is normal or whether it is down any number of decibels, so long as its bone conduction is near normal.

If the bone conduction is down in the ear under test no crossed masking from the opposite side will occur unless masking sounds sufficiently loud to overcome the loss are used. Of course, it is impossible to mask out an ear by a bone conduction masking sound without masking also the contralateral ear, unless the latter ear is deafened by a neural lesion sufficiently great to prevent its threshold being reached by the masking sound. But there is no need of masking if the contralateral ear (the ear being masked) is down by air conduction and bone conduction more than the ear under test, no matter what the degree or type of loss in the contralateral ear.

The trouble is that the otologist does not know when this condition exists without careful testing and without, as well as with, masking to determine it. It is

apparent, therefore, that for true determinations of thresholds contralateral air conduction masking sounds must be kept below intensities detectable by the ear being tested. It should also be obvious that patients should first be tested without masking, and then, if the hearing in the two ears differs by more than 35 to 50 decibels, masking should be used. It should be obvious that for air conduction tests it is not necessary to mask a poorer ear unless its bone conduction loss is nil, or at least less than that in the ear under test.

Care should always be taken to use the minimum intensity necessary to mask. A simple technic to determine the maximum (optimum) nondetectable masking intensity (applied to a better hearing ear) is first to obtain the threshold for the test frequency in the poorer ear, then to introduce the masking sound into the contralateral ear, first well below its threshold and then slowly to increase it, noting when it causes a shift in threshold (an elevation of the threshold) in the ear being tested. The intensity of the masking sound is increased until it just affects the hearing threshold of the ear under test, and then it is diminished 5 decibels. This point will be the limit in intensity one can use without endangering true results. No means have been invented to overcome this intensity limitation, so far as threshold bone conduction determinations are concerned.

One reason for the current multiplicity in symbols used in audiograms is that some of the manufacturers of audiometers printed their charts without consulting well informed otologists. Another reason is that the printers of the standard chart issued by the Advisory Committee on Audiometers and Hearing Aids inadvertently omitted the dot (.) for the right ear and the circle (o) for the left ear, as approved by its subcommittee appointed with power to determine the final form of the standard audiogram chart for estimating the percentage in loss of capacity to hear speech. Incidentally, the method adopted for the percentage determinations was a compromise, because, although the air determinations recommended by Fowler were adopted, the bone conduction and binaural varying ratios with differing degrees of deafness recommendations were not adopted for determining percentage loss in capacity. The committee consisted of Walter Hughson, Paul E. Sabine and Edmund P. Fowler.

Still another reason for present confusion was a printer's clerical error in the charts prepared for the 2A audiometer, which reversed the bone conduction symbols. They were inadvertently printed] [instead of [ ]. All agree that the latter arrangement is far preferable. Let us hope that it will be universally used.

Since some workers do not use the symbols I recommend, then, as advised by the Advisory Committee on Audiometers and Hearing Aids of the American Medical Association, the chart should have printed on it what symbols are used. But why make this procedure necessary? Why not use the symbols as originally devised? None seem more appropriate, and they have been tested and found suitable in hundreds of thousands of audiograms over the years; moreover, they have become standard for many clinics and states and in some countries.

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HEARING AND SPEECH PROBLEMS IN CHILDREN

Observations and Use of Electroencephalography

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THE CHILD under 3 years in whom a hearing loss is suspected or whose speech is poor, perhaps absent, is usually taken by his parents to the family physician, pediatrician, otologist or, occasionally, to a psychiatrist. The parents, of course, are deeply concerned and are anxious to know whether or not their child is, in fact, hard of hearing and, if so, what caused the defect, as well as, finally, what they can do about it. With regard to such a child, the physician finds it extremely difficult to provide the answers, especially to the first question. The diagnosis of hearing loss in the young child is a formidable problem, and the ordinary physician's office is not equipped to measure the extent of hearing impairment.

The child does not cooperate well. He is fussy, frightened and inattentive. The tests of hearing used for adults are not applicable to the child under 3 years because he cannot make his sound perception known. The clinical tuning forks are not an adequate source of sound stimulation by air and are valueless as a measure of bone conduction in children of this age. The audiometer, obviously, cannot be used in the usual manner. Loud speech, drums, cymbals, whistles, cowbells and ratchets can be used, but the aural palpebral reflex or head-turning reflex are difficult to evaluate, considering the possibility that these may have been elicited by visual or tactile stimuli unknown to the tester. Furthermore, the eyeblink or head turning toward the sound may have been coincidental.

The physician, then, on the basis of his experience or intuition, may state that the child is, or is not, hard of hearing. If the child is hard of hearing, the physician may advise the parents as to the probable cause (history having been taken and complete otological examination, including all tests of labyrinthine function, having been done) and outline the treatment as well as the educational needs. There are times, however, when the parents are held off with a noncommittal statement or are requested to return "when the child is old enough to test," perhaps when "he is 6 years old." It is indeed unfortunate if the latter phrase is said, inasmuch as the hard of hearing child's entire social development hinges on the availability of an early education, which should be begun as soon as possible, preferably at or about the age of 3 years.

Candidate's thesis presented in partial fulfilment of the requirements for membership in the Chicago Laryngological and Otological Society.

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All who carry a responsibility for the child suspected of hearing impairment should follow the maxim "The child is hard of hearing until proved otherwise." If, after adequate otological examination and careful hearing testing, the child has been found to have normal hearing, nothing has been lost. On the contrary, the parents are reassured. If a diagnosis of profound loss is made, the parents can be prepared for treatment, should that be advisable, and also for specific procedures of education and rehabilitation.

The testing of auditory function in the child under 3 years is admittedly a laborious and exacting process. In a review of the literature, Utley [1] mentions the observations of various authors in regard to normal responses to different sounds in children, from the newborn to those 5 years of age. The neonate gives a reflex response to the Urbantschitsch whistles but not to the pure tones. Citing Ewing, Utley states that children under 5 years give an unreliable response to the pure tone because of their limited span of interest and attention. Utley uses a conditioned reflex method by which the child is taught to move a block at the sound, without being aware of the source of the sound. Other workers [2] use various types of conditioning tests, but all depend on the full cooperation of the child and may need frequent repetition for an adequate opinion to be drawn. The child must be at least 18 months old, but it is usually the 2 or the 2½ year old that can perform reliably in a conditioned reflex system of auditory acuity measurement.

It is desirable, then, to be able to measure the hearing acuity of a child of any age in a situation in which his conscious participation is not needed. In these circumstances, the electroencephalograph would seem to be an ideal instrument of measure. An experience with 19 children with use of the electroencephalograph has been previously reported.[3]

The electroencephalograph is a complex electrical device designed to pick up the minute electrical impulses generated during brain activity. In its function it is similar to the electrocardiograph, but the brain voltages are approximately 1/100 of those of heart muscle. Furthermore, the brain is a much more intricate organ, concerned with widely divergent activities, and covers considerably more physical space. According to Gibbs, the brain "beats like a whole population of tiny hearts." [4]

The electroencephalograph amplifies the brain voltages through vacuum tubes and records them on a wide paper tape as "waves" by means of ink-writing voltmeters. The voltages are picked up by spherical electrodes placed over certain areas of the scalp; one electrode is attached to each ear lobe. The electrodes are maintained on the scalp by collodion. The instrument used in this study is of the eight channel type, manufactured by the Grass Institute, of Quincy, Mass.

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1. Utley, J.: Suggestive Procedures for Determining Auditory Acuity in Very Young Acoustically Handicapped Children, Eye, Ear, Nose & Throat Monthly **28**:590 (Dec.) 1949.

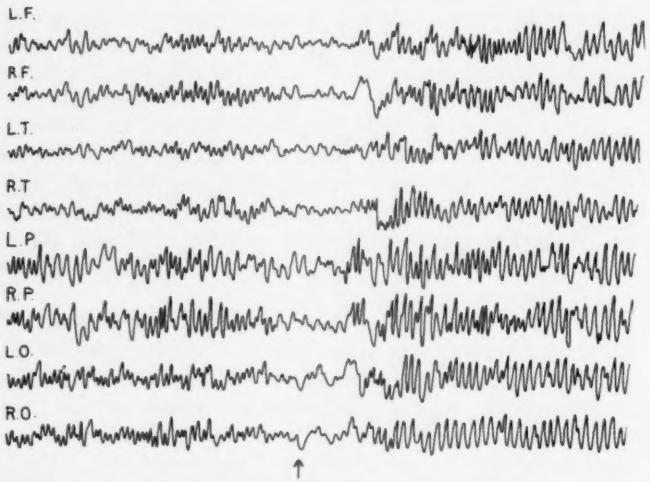
2. Dix, M. R., and Hallpike, C. A.: The Peep Show: New Technique for Pure-Tone Audiometry in Young Children, Brit. M. J. **2**:719 (Nov.) 1947. Bordley, J. E.; Hardy, W. G., and Richter, C. P.: Audiometry with the Use of Galvanic Skin-Resistance Response: Preliminary Report, Bull. Johns Hopkins Hosp. **82**:569 (May) 1948.

3. Marcus, R. E.; Gibbs, E. L., and Gibbs, F. A.: Electroencephalography in the Diagnosis of Hearing Loss in the Very Young Child, Dis. Nerv. System **10**:170 (June) 1949.

4. Gibbs, F. A., and Brown, R. F.: What are the Brain Waves Saying? Mod. Hosp. **70**:43 (April) 1948.

Electroencephalography is a well established, though comparatively recent, clinical procedure.[5] Its history, however, dates back to the time of Caton, who demonstrated electrical activity in the brains of animals in the middle of the nineteenth century. It has been developed into a diagnostic aid of the first order by Hans Berger, beginning in 1925,[6] and by others after him. The pattern of brain voltages, as traced on the paper tape, has a more or less regular rhythm that may be altered by disease. Brain tumors, epilepsy, encephalitis, cerebral vascular changes and certain intoxications can change the rhythm by causing a reduction, or an increase, in the rate, a greater or less amplitude or paroxysmal breaks in rhythm. Localization of tumors or of brain damage may be helped by electroencephalography.

In a preliminary report [8] is described the method of utilizing the electroencephalograph in the determination of hearing loss in children. It had been previously noted that during sleep, after any sensory stimulation, the brain wave



Record taken with an eight channel electroencephalograph from eight cortical areas, with a reference electrode formed by interconnecting the two ear lobes, showing arousal from sleep as a result of sensory stimulation at the arrow.

To the left of the arrow and for a short distance to the right, the wave forms are those which are characteristic of sleep, but the last third of the record shows waking activity. In this instance the stimulus was the whispered name of the patient, but any sensory stimulation, if sufficiently intense or meaningful, will produce the same disappearance of sleep patterns.

rhythm changed from a "sleep" to a "waking" pattern. This nonspecific arousal response (see figure) is used as a criterion of cerebral perception of sound. It is not a quantitative measurement in the strict sense but is, rather, an objective indication of whether or not the sound was heard. It is possible, of course, to note the extent of the arousal response as compared to the intensity of the auditory stimulus. For the purposes of this study, however, it was desired to know whether

5. Gibbs, F. A.: The Present Status of Clinical Electroencephalography, Bull. New York Acad. Med. **25**:764 (Dec.) 1949.

6. Gibbs, F. A., and Gibbs, E. L.: Atlas of Electroencephalography, Boston, The Authors, 1941.

a child did or did not hear. Calibration of the sound intensity had been planned, but several technical problems have not as yet been overcome, i e., the effect of another electrical circuit on the delicate one of the electroencephalograph. We hope to develop such a system.

The electroencephalographic examination is conducted in a pleasantly furnished room in which a comfortable bed is placed. The furnishings are simple, with pictures on the walls to allay the fears of children. The electrodes are arranged in pairs in the following locations: (1) the frontal bosses, (2) the temporal areas, (3) the parietal area, just above the ears and on a line with the eyes, (4) the occipital protuberances and (5) the ear lobes (reference electrodes). The hair is not shaved, merely separated. The scalp is cleaned and dried with acetone, and the electrodes are fixed in position with collodion, which is dried with a stream of compressed air. The technicians are well trained nurses or psychologists who are extremely competent with children. The mother remains with the child at all times.

Those children up to 3 years, still in the habit of taking an afternoon nap, are scheduled for electroencephalography just after the noon meal. In most instances the procedure of arranging the electrodes does not upset the child, and he falls asleep quickly. Some children, however, are disturbed by the strange surroundings and maneuverings and may become tense and highly attentive. In such cases, the child is given an elixir of one of the barbiturates, according to the accepted doses for children, and, usually after a half hour or so, he relaxes into sleep.

The older children usually are not frightened, and their cooperation is more easily obtained. Some children are hyperactive as part of their clinical syndrome, and they must, therefore, be sedated prior to the application of the electrodes. It is fundamental to this test that the children be asleep, inasmuch as the measure of sound perception is, as explained previously, the arousal response: the electroencephalographic change from a sleeping to a waking pattern. Occasionally, even the sedative effect of the barbiturates is insufficient to obtain adequate relaxation for sleep, in which instance the children are scheduled for electroencephalography during a night's sleep. They are brought to the clinic in the middle of the evening and fall asleep at their usual hour.

With a cooperative child, the test consumes the greater part of an hour. When sedation becomes necessary, the test may take two hours, rarely two and a half hours. When the child drowses, or is quietly awake, the electroencephalograph is turned on, and the recording voltmeters begin to register. Standard base lines are obtained and the normality (or abnormality) of the waking record is established. As soon as the pattern becomes steady, the technician signals to the tester, who runs through the series of sound stimuli. In each instance the mother calls the child's name, first in a whisper, then gradually increasing the volume to a loud call if there is no response. Failing an arousal tracing, the tester uses a police whistle, a cowbell, a tom-tom, beating on a pan and pitch pipes, in all instances carefully avoiding any tactile stimulation. Each ear is tested separately, if possible. It is necessary to watch the tracing to insure that the child is not too deeply asleep, since light sleep is desirable. The child too deeply asleep develops an extremely high threshold for any stimulation, and the test may be unreliable on that basis. The arousability of the child must always be determined by using olfactory

stimulation with acetone as a control procedure. If the child does not show an electroencephalographic arousal reaction with either auditory or olfactory stimulation, it is assumed that he is too deeply asleep. Enough patients have been tested in this and control series to allow the electroencephalographers to gage the effect of the barbiturates. If sleep by sedation is too profound the hearing testing is postponed for another occasion.

The control stimulation with acetone is carried out as follows: A cotton ball soaked with acetone is held under the subject's nose. The odor of acetone is strong and even irritating, so that it probably stimulates the fifth, seventh and ninth cranial nerves, in addition to the first cranial nerve. Although acetone as an odor may not stimulate the olfactory nerve alone, it probably has its major effect on that one, and it has functioned adequately for the purposes in the present study. For each stimulation, whether auditory or olfactory, a mark is placed on the tracing at the exact moment of stimulation so that any arousal response can be accurately evaluated in relation to the stimulation. The tester signals the technician by a hand wave each time a stimulus is applied.

REPORT ON SERIES OF SEVENTY-ONE PATIENTS

Seventy-one patients from the Speech and Hearing Clinic of the Illinois Eye and Ear Infirmary and the University of Illinois hospitals were studied in the clinic and under electroencephalographic conditions in sleep. Originally, it had been intended to use the electroencephalograph for hearing testing only, but as the study developed, it was noted that some children who had poor or no speech but good or moderately impaired hearing showed an unusually high percentage of electroencephalographic evidence of brain damage. The study, therefore, was extended to include those children with delayed or unintelligible speech and/or hearing defects.

Complete medical and pediatric histories were obtained from the mothers when possible. Otological examination included inspection of the nose, mouth, pharynx, nasopharynx and the tympanic membranes. Labyrinthine function was tested first by rotation, and, if it was reduced or absent, the test was followed by caloric stimulation. If caloric stimulation elicited no nystagmus, labyrinthine function was considered nonexistent. Routine blood tests for syphilis and the Rh type were done on the mother and the child and, if possible, on the father. Roentgenograms of the mastoid processes or other regions of the body were taken if considered necessary to establish a diagnosis. All other laboratory and serologic tests were done when indicated. Consultation was sought frequently with the departments of pediatrics, neuropsychiatry, orthopedics, ophthalmology and dermatology in order to complete the diagnostic survey. Psychometric testing was done with the cooperative children, and hearing evaluations were done in the clinic on all the children prior to electroencephalography.

The ages ranged from 10 months to 12 years (table 1). Forty-two children were under 4 years. Twenty-nine were over 4. Of the 29, there were 21 who were 6 years old or less, and 8 were 7 years or older. There were 53 males and 28 females, a ratio of almost 2:1 (table 2).

An attempt was made to establish the cause of the hearing loss or the speech retardation by obtaining a detailed history, supplemented by hospital records of disease and obstetrical summaries and thoroughgoing laboratory evaluations. The following information is listed in table 3.

1. Rh incompatibility was proved in four patients and was questionable in one. The diagnosis of Rh incompatibility was made on the criteria of (*a*) a history of jaundice in the neonatal period and (*b*) blood samples of the mother, father and

TABLE 1.—*Age of Children in Series*

Under 4 years	42
From 4 to 6 years	21
From 7 to 11 years	8
Total	71

TABLE 2.—*Sex of Children in Series*

Male	53
Female	28
Total	71
Ratio + 2:1	

TABLE 3.—*Etiologic Factors*

Factors	Number of Patients		Comment
Rh factor	5		Questionable in 1
Rubella	7		.....
Premature birth	6		1 child also with Rh factor; 2 also twin
Twin	5		1, survivor of other twin, both having had Rh factor jaundice; 2 also premature; 2 smaller of twins, weighing 5½ pounds or less but full term—larger twin 7½ pounds or more
Birth injury	2		Presumed by history in 1, proved by spinal tap in the other
Infectious diseases	4		
Meningitis	2		Streptomycin received by both
Influenzal	1		
Tuberculous	1		
Mumps	1		
Measles encephalitis	1		
Unknown and other causes	45		Mothers over 36 at time of birth in 2 cases; mothers with miscarriages prior to or bleeding during pregnancy in 4
Total	71		

child that showed the mother to be Rh negative and the father and child Rh positive. There were instances in which the father was Rh negative but the mother and the child were positive. Such cases were not included, but the question of blood incompatibility should be further explored.

2. Rubella occurring in the first trimester was noted in six patients as the only positive factor in the history.[7] One child's mother had rubella at 7½ months

7. Beswick, R. C.; Warner, R., and Warkany, J.: Congenital Anomalies Following Maternal Rubella, Am. J. Dis. Child. **78**:334 (Sept.) 1949.

gestation, but here it is considered of questionable etiological significance. The criteria for a diagnosis of rubella were these: (*a*) a history of malaise preceding a measly rash of 24 to 36 hours' duration; (*b*) a substantiation by the attending physician; or (*c*) an occurrence of symptoms during a proved outbreak of rubella, though diagnosis was not substantiated by a physician.

3. Prematurity occurred with six children, one of whom also had an Rh incompatibility and two of whom were also twins. To be classified as premature, the child had to weigh less than 5½ pounds (2,495 Gm.)—definition of American Academy of Pediatrics.

4. Five of the patients were one of twins. One of these was a twin whose partner died shortly after birth, and both had had erythroblastosis. This child was also athetoid. Two of these children were also premature. Two children in this group were the smaller of twins by a considerable margin, and both weighed less than 5½ pounds, whereas the other twin weighed 7½ pounds (3,402 Gm.) or more.

5. Birth injury, although probably occurring much more frequently than could be proved,[8] was considered of etiological importance in two children. These were two in whom cyanosis, respiratory difficulty and convulsions occurred immediately after birth and in one of whom spinal tap established the diagnosis.

6. Infectious diseases were found in the histories of four children. Two children had meningitis, one influenzal and one tuberculous. The diagnoses for both were confirmed by spinal tap and culture, and both received a combination of antibiotic therapies, including that with streptomycin. In one of this group deafness developed immediately with the mumps, and another child became deaf during an attack of measles encephalitis.

7. There were 45 children in whom no definite etiological factor could be established by present knowledge. It is interesting that in this group two of the children were only children born when their mothers were 36 and 38 years old respectively. Four in this group were born of a pregnancy immediately following a natural abortion or a pregnancy marred by bleeding during the first trimester.

8. Only one child showed presumptive evidence of an inherited defect. The mother was "congenitally deaf," and the father was hard of hearing.

9. There was no consanguinity.

10. There were no cases of proved syphilis.

Four of the children also had the classic signs and symptoms of cerebral palsy; three had the spastic type and one the athetoid. Two of the children with the spastic type and one with the athetoid type had Rh incompatibilities, as proved by blood studies. The other spastic child had convulsions and became deaf and spastic at 10 months of age, prior to which time she was normal. Others in the complete series had incoordinations of gait or ocular defects, or both.

Certain observations were made that seemed unrelated to the hearing loss (table 4): 1. Ten had a history of slowed development. Most of these children did not sit up, crawl or walk until long after the usual time. 2. The condition in four had been previously diagnosed as cerebral palsy, three spastic, one athetoid.

8. Hughes, J. G.; Ehemann, B., and Brown, U. A.: Electroencephalography of the Newborn, Am. J. Dis. Child. **76**:626 (Dec.) 1948.

3. Eight children had anomalies of gait, other than that resulting from meningitis, and showed more incoordination of extremity musculature. 4. Four had ocular defects, all variations of strabismus. 5. Six had manifest convulsions. 6. Four had prominent frontal bosses. 7. Serious behavioral distortions occurred in 18, of whom 14 showed a marked hyperactivity and four had temper tantrums. The hyperactive children seemed charged with an inexhaustible energy, but withal an inability to maintain a normal period of concentration or attention. They moved from one toy to another, walked or ran constantly from one interest to another,

TABLE 4.—*Historical or Physical Findings Other Than Hearing Loss*

Slowed development		10
Cerebral palsy		4
Spastic	3	
Athetoid	1	
Anomalies of gait other than that of meningitis		8
Ocular defects		4
Convulsions		6
Prominent frontal bosses		4
Anomalies of behavior		18
Hyperactivity	14	
Temper tantrums	4	

TABLE 5.—*Labyrinthine Function (Nystagmus)*

Rotation normal	62
Rotation absent but caloric normal	2
Rotation and caloric absent (2 meningitic, 5 of unknown origin)	7
Total	71

TABLE 6.—*Clinical Evaluation of Hearing Prior to Electroencephalography*

No hearing	19
Below 80 decibels	20
Below 60 decibels and above 80 decibels	7
Below 30 decibels and above 60 decibels	6
Above 30 decibels	15
Variable	4
Total	71

did not take naps or fall asleep until late at night or slept fitfully after getting to bed. The temper tantrums frequently occurred without provocation and were all beyond the usual behavior of the normally frustrated child, or even the frustrated deaf child.

The important otolaryngological findings were limited to labyrinthine function and hearing evaluation (table 5). Normal nystagmus was elicited in 62 children on rotation in the Bárány chair. The nystagmus was absent on rotation in two, but it was normal in these two subjects when caloric stimulation was used. No nystagmus was elicited after the use of both rotation and caloric stimulation in seven children, in two of whom the condition was postmeningitic. The cause of the condition in the other five was listed as unknown.

Prior to electroencephalography, hearing was tested in the clinic (table 6) in a uniform manner by the same person (Utley) with a conditioned reflex technic. No hearing could be demonstrated in 19 children. Hearing was below 80 decibels in 20, below 60 but above 80 decibels in 7, below 30 but above 60 decibels in 6 children and variable in 4.

There was a group of 18 children with serviceable or moderately impaired hearing, but with absent, retarded, unintelligible or inconsistent speech, on whom electroencephalography was done (table 7). These children had been brought to the clinic because the speech delay or distortion was believed to be due to a hearing

TABLE 7.—*Data on Children with Serviceable or Moderately Impaired Hearing, but with Absent, Retarded, Unintelligible or Inconsistent Speech*

Etiologic Factors	Number of Patients	Comment
Rh factor	2	
Twin	3	2 also premature
Premature birth	5	2 also twin
Rubella	1	
Ages		
Over 3 yr.	16	
Over 2 and under 3 yr.	2	
Total	18	

TABLE 8.—*Electroencephalographic Arousal Response*

Auditory Stimulation	
Arousal response	44
Questionable response	2
No response	25
Olfactory-Taste (Acetone) Stimulation (Control)	
Arousal response	62
Sluggish response	7
No response	2

TABLE 9.—*Correlation Between Hearing Obtained in Clinic and by Electroencephalography*

Clinical hearing obtained but no arousal on EEG	7
No clinical hearing obtained, but arousal on EEG	1

impairment. A complete evaluation had to be done in order to rule out hearing loss as a factor in the speech difficulty.

In the 71 children tested under electroencephalographic conditions in sleep, the arousal response to auditory stimulation on the electroencephalographic tracing was elicited in 44, questionable in 2 and was not obtained in 25 (table 8). Correlation of the arousal response with the clinical hearing evaluation was obtained in all but eight, seven of these children showing no arousal tracing, whereas hearing was demonstrated in the clinic by conditioned reflex, or believed to be; one child showed an arousal, whereas no hearing had been demonstrated in the clinic (table 9). All but two children responded to the acetone control, 62 promptly and markedly, seven sluggishly. One of the two that did not respond to acetone also did not respond

to sound, although hearing had been demonstrated in the clinic. There is no explanation of the reason for lack of response to acetone stimulation, although it may be that in a very few of these children one is dealing with a generalized sensory lesion in that they could be awakened only with great difficulty by pinching or slapping the bottom of the feet. The lack of response to acetone might also be related to the type of sleep in these children.

TABLE 10.—*Electroencephalographic Evidence of Brain Damage*

Damage in patients with hearing loss as primary difficulty	
Number of patients	53
Abnormal EEG's	19
Percentage of abnormal EEG's	37.7 per cent
Damage in patients with speech defect (delayed or unintelligible)	
Number of patients	18
Abnormal EEG's	9
Percentage of abnormal EEG's	50 per cent

TABLE 11.—*Brain Damage in Children with Hearing Loss*

Name	Age, Yr.	Type of EEG	Localization
T. G.	3	1. Moderate abnormal fast 2. Mild slow activity	Diffuse
J. B.	5	14 and 6 per second positive spikes	Left temporo-occipital
G. P.	3	1. Amplitude asymmetry 2. Seizure activity	1. Left temporo-occipital 2. Generalized
L. R.	5½	1. Moderate slow activity 2. Moderate abnormal fast	1. Left temporo-occipital 2. Bitemporal
V. K.	3	Moderate abnormal fast	Left temporoparietal
C. T.	2¾	Moderate abnormal fast	Left temporal
M. A. S.	2½	Moderate slow activity (4 to 6 per second)	Left temporoparietal
P. S.	5½	1. Spike seizure focus 2. 14 and 6 per second positive spikes	1. Right temporal 2. Bilateral
K. B.	5	Moderate abnormal fast	Bitemporal
D. S.	5	14 and 6 per second positive spikes	Left temporo-occipital
J. D. I.	5	1. Moderate abnormal fast 2. Amplitude asymmetry	1. Left temporal 2. Left occipital
N. H.	2	1. Diffuse spike seizure activity 2. Independent spike seizure focus	1. Bifrontoparietal 2. Left frontoparietotemporal
P. R.	5	Spike seizure focus	Right temporal
P. W.	6	1. Seizure activity 2. Independent spike seizure focus	1. Diffuse generalized 2. Bioccipital
C. C.	8	Spike seizure focus	Right temporal
M. S.	1	Very abnormal fast	Generalized
T. D.	2	Spike focus (independent)	Left temporal Right temporal
P. P.	3½	Very abnormal fast	Diffuse
R. B.	3½	1. Spike seizure focus 2. Amplitude asymmetry	1. Left temporal 2. Left hemisphere

Twenty-eight of the 71 children had abnormal electroencephalograms. In the group previously referred to, with serviceable hearing but with speech delay or distortion, half the children, nine of the 18, had abnormal electroencephalograms. Of the 53 children whose hearing was markedly impaired, 19 had abnormal electroencephalograms (table 10). It is of interest to note the localization of the brain damage (tables 11 and 12). As indicated in the 19 abnormal electroencephalograms of the 53 "deaf" children, the damage in 10 was localized in the left

temporal area, in four in the right temporal area and in one in both temporal areas; in four the lesions were diffuse or generalized. Of the nine abnormal electroencephalograms of the 18 "speech defective" patients, three showed localization in the left temporo-occipital area, one in the left temporoparietal area and three in the right temporo-occipital or temporal region. In two the lesions were diffuse or generalized. The preponderance of temporal lesions in patients both with hearing and with speech defects is apparent and may speak for the possible significance of the temporal lobes in hearing and speech control.

COMMENT

The background of hearing loss in the young child is relatively unexplored, particularly in the areas of etiologic diagnosis and central nervous system disease. Hearing function rightfully should be viewed in its context of peripheral end organ, sensory nerve, brain stem, cerebral ramifications and motor expression. The

TABLE 12.—*Brain Damage in Children with Speech Defect*

Name	Age, Yr.	Type of EEG	Localization
M. A.	4	Moderate slow activity (4 to 6 per second)	Left temporo-occipital
R. H.	4½	14 and 6 per second positive spikes	Right temporo-occipital
R. B.	4½	Spike seizure focus 14 and 6 per second positive spikes	Right temporo-occipital Both hemispheres
G. W.	7	Moderate slow activity 14 and 6 per second positive spikes	Biparietal Left temporo-occipital
R. K.	6	Moderate slow activity	Generalized
J. B.	6½	14 and 6 per second positive spikes	Both hemispheres
R. U.	7	14 and 6 per second positive spikes Spike seizure focus	Right temporo-occipital Right temporal
B. P.	5	14 and 6 per second positive spikes	Left temporo-occipital
R. K.	12	Spike seizure focus	Right temporal

electroencephalograph, on the basis of these studies, appears to be able to offer the clinician added information in regard to such an understanding. It gives (1) a qualitative estimate of the presence or absence of an intact end organ and (2) an objective method of determining the presence or absence of brain damage to substantiate the possibility of a central nervous system defect in the hearing-speech-sensory-motor arc.

Electroencephalography makes it possible to determine the integrity of the cochlea in children under 6 years. It can be added to the clinician's routine examination of the infant and young child in the same way as the roentgenogram is added for clinical definition in certain diseases. Other tests can and should be used, and others undoubtedly will become available in the future.

The second body of information given by the electroencephalogram may prove to be of value not only in present clinical diagnosis and research but also in clarifying educational technic for the future. Combining present otological procedure with electroencephalography in selected cases, one may now be able to be more specific in the differential diagnosis between cochlear disease and central nervous system

dysfunction or aphasia. Peacher,[9] in advising that electroencephalographic evidence is unavailable, states that such differential diagnosis is difficult, although many workers[10] have long been concerned with the problem. The problem becomes of importance when it is realized that many children are treated as deaf when actually they may have some variation of sensorimotor aphasia or a severer type of brain damage. Cloud[11] and other educators of the deaf have for years realized that there were some so-called deaf children who could not be taught to speak by the usual methods and yet did not lack for intellectual ability. These children, in spite of the obvious detriment of having to speak with their hands (i. e., the manual method), had no other way open for them to use speech symbols. Kline[12] believes that perhaps 20 per cent of such children are enrolled in the Illinois State School for the Deaf. It is possible that these children are aphasic and may not belong in a school for the deaf. Separate special educational technics are needed for them.

It is also possible, with present trends in neurosurgery and in improvement of medications for central nervous system disease, that these children may be helped by medical therapy or by a neurosurgical procedure of the future in which the specific damage may be alleviated or repaired. The development of cybernetics[13] may delineate other pathways to provide serviceable hearing-speech arcs when peripheral organ or central nervous system damage prevents normal function.

CONCLUSIONS

1. The diagnosis of hearing loss in the very young child is a formidable problem, and complete history, physical examination, laboratory procedure and hearing tests must be utilized by the physician.

2. Many of the children with hearing loss in this study showed other clinical abnormalities, including disorders of gait, slowed development, behavioral disturbances and strabismus.

3. Factors of etiological significance were found to include the presence of rubella in the mother during the first trimester of pregnancy, Rh blood type incompatibility, prematurity, twinning and brain injury at birth. Consanguinity, heredity and syphilis could not be demonstrated to be of importance in this series.

4. In this study the males outnumbered the females by a ratio of 2:1.

5. Electroencephalography in sleep has been found to be valuable in the diagnosis of hearing loss and speech defects in young children.

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11. Cloud, D.: Personal communication to the author.

12. Kline, T.: Personal communication to the author.

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6. Electroencephalographic arousal response to appropriate stimuli is an adequate index of hearing or other sensory function and may be used in the early diagnosis of hearing loss in the infant and preschool child.

7. Electroencephalographic evidence of intracranial disorder was found in 19 of 53 children in whom a severe hearing loss was established in the clinic.

8. Electroencephalographic evidence of intracranial disorder was found in nine of 18 children (with slight to moderate hearing impairment) who presented delayed, retarded or unintelligible speech.

9. Electroencephalographic evidence of intracranial disorder in both the hearing and the speech defective children showed, in localization, a preponderance in one or the other of the temporal lobes.

10. The possibility of disturbed cerebral control of auditory interpretation must be considered a factor in the clinical manifestation of "deafness" in the so-called congenitally deaf child.

11. Disturbed cerebral control appears to be a factor in delayed, absent or unintelligible speech in the young child.

307 North Michigan Boulevard.

The electroencephalography was done and interpreted by E. L. Gibbs and F. A. Gibbs, M.D., University of Illinois College of Medicine, Department of Psychiatry, and the Illinois Neuropsychiatric Institute.

CHOLESTEATOMATOUS CYSTS SECONDARY TO INCOMPLETE REMOVAL OF THE CHOLESTEATOMATOUS MATRIX

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AND
HENRY L. WILLIAMS, M.D.
ROCHESTER, MINN.

ALTHOUGH external cholesteatomatous cysts of the mastoid region that develop subsequent to radical operations for the removal of aural cholesteatomas are unusual, we feel that the occurrence of such a complication constitutes a reason for the complete removal of the cholesteatomatous matrix in the surgical treatment of cholesteatomas of the middle ear and the mastoid.

"Cholesteatoma" was defined by Morrison [1] as "a mass of layers of cast off epithelial cells with fatty degeneration and cholesterin crystals on a matrix of subepithelial connective tissue with a squamous epithelial covering."

Authorities are divided in their opinions as to the efficacy of complete removal of the matrix in the surgical treatment of this lesion. In 1893 Siebenmann [2] advocated preservation of this structure, feeling that its presence simplified and accelerated the healing process. Nager [3] agreed with this concept, writing that the matrix could not be replaced with anything better. Almour [4] stated that the matrix represents for the surgeon the ultimate lining with which he seeks to cover his technically created tympanomastoid cavity. He added that during the course of postoperative care any eczematoid condition resulting from long-standing irritation from superimposed collections of dead cells could soon be controlled and that the squamous epithelium would return to normal. He felt that the essential point was to provide for an adequate egress for products of desquamation, and he stated that unless the cholesteatoma had invaded the brain, produced a septic thrombus of the sigmoid sinus or bulb or resulted in a suppurative labyrinthitis, the operation should be limited to removal of the tumor mass, leaving the matrix in situ.

He warned that under certain conditions removal of the matrix might create a pathway of infection into the membranous labyrinth, the fallopian canal or the

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Fellow in Otolaryngology and Rhinology (Dr. Begley), Mayo Foundation.
From the Section on Otolaryngology and Rhinology (Dr. Williams), Mayo Clinic.

1. Morrison, W. W.: Diseases of the Nose, Throat and Ear, Philadelphia, W. B. Saunders Company, 1938, pp. 568 and 574.

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3. Nager, F. R.: The Cholesteatoma of the Middle Ear: Its Etiology, Pathogenesis, Diagnosis and Therapy, Ann. Otol., Rhin. & Laryng. **34**:1249-1258 (Dec.) 1925.

4. Almour, R.: The Surgery of Chronic Otorrheas, in Kopetzky, S. J.: Surgery of the Ear, ed. 2, New York, Thos. Nelson & Sons, 1947, pp. 187-217.

lateral sinus. Baron [5] defended this stand, declaring that the danger from the cholesteatoma was gone once it had been opened adequately and the factor of pressure eradicated. He admitted, however, that there were exceptions in cases of revisions of previous radical or modified radical operations, in which there was the possibility that secondary subepithelial cholesteatomatous cysts might develop from remnants of the matrix. This reference to the possible development of such cysts was the only one encountered in a survey of the literature. Other authors [6] agreed that the matrix should not be disturbed. One of us [7] (H. L. W.) formerly subscribed to this concept.

In 1911 Richards [8] described Heath's operative technic and stated that every cholesteatomatous focus must be removed or suppurative recurrence would take place. The Ballengers [9] stated that even after the most thorough radical operation the disease might persist. They felt that this situation was not difficult to understand, since a cholesteatoma can force its way into the haversian canals of bone or result in saclike prolongations into the bone. They said that thorough surgical removal of the lesion was warranted. Jackson, Coates and Jackson,[10] and Lederer [11] stressed the tendency of a cholesteatoma to invade microscopic structures; they advocated its complete removal. Others [12] shared this viewpoint. Lautenschläger [13] was said to have demonstrated that the process which destroys bone during the enlargement of a cholesteatoma is the chemical effect of cholesterol and not the mechanical pressure of the tumor. This observation would seem to be evidence in favor of a procedure more complete than that of simply providing egress for the products of desquamation.

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13. Lautenschläger, cited by Eggston, A. A., and Wolff, D.: Histopathology of the Ear, Nose and Throat, Baltimore, Williams & Wilkins Company, 1947, p. 433.

Following are the reports of two cases of external cholesteatomatous cysts of the mastoid encountered at the Mayo Clinic. In each instance the lesions developed after radical operations for the removal of aural cholesteatomas.

These two cases are outstanding examples of the type of trouble that occasionally has been observed during the past 20 years to follow preservation of the cholesteatomatous matrix. It is this evidence that has caused one of us [7] (H. L. W.) to change his opinion, which had been in favor of preservation of the cholesteatomatous matrix, to one in which he strongly opposes this practice.

REPORT OF CASES

CASE 1.—A woman 22 years old gave a history of a "head cold" which had occurred 15 years previous to her visit to the clinic. This affliction had been followed by purulent drainage from her left ear that had been persistent ever since. Nine years after the onset of the otorrhea, modified radical mastoidectomy on the left had been performed elsewhere, but the drainage continued. Two years later a "cyst" was removed from the mastoid scar and polyps were removed from the middle ear. She stated that her hearing was very poor in the involved ear. There was no history of pain, tinnitus, vertigo or vomiting. The patient's own as well as her family history was noncontributory.

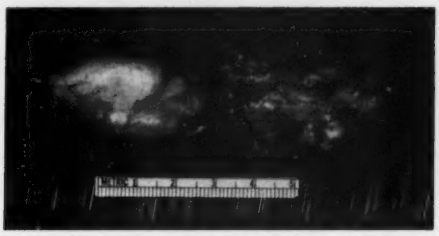

Fig. 1 (case 1).—External cholesteatomatous cyst of the mastoid process, with contiguous cholesteatomatous matrix.

On examination, the cavity of the left ear was found to be full of a yellow purulent discharge. There were polypoid granulations along the posterior-superior portion of the cavity and covering the area of the tympanic membrane. There was a cystlike mass beneath the mastoid scar, which extended inferiorly into the neck. Results of the remainder of the examination of the ear, nose and throat were essentially negative.

The general physical examination indicated nothing significant, nor did a roentgenogram of the thorax and urinalysis and serologic procedures disclose any abnormalities. The hemoglobin determination and the erythrocyte and leukocyte counts were within normal limits. Roentgenograms of the mastoid processes revealed bilateral sclerosis and the suggestion of a cholesteatoma on the left.

A diagnosis was made of "chronic suppurative otitis media with mastoiditis, cholesteatoma and a cyst." Secondary radical mastoidectomy was performed via a postauricular approach. A sausage-shaped cyst about 5 cm. long and 2 cm. in diameter was dissected up from the neck into the mastoid, where it appeared to be continuous with the cholesteatomatous matrix. The cyst was filled with a cheesy material. The sigmoid sinus had been uncovered at the previous operation; it was adherent to the cyst, but it was separated without causing a tear in the vessel. The cholesteatomatous matrix was completely removed from the mastoid antrum, epitympanum and cavity of the middle ear, and the remainder of the radical mastoidectomy was completed. A skin graft was cut from the anterior surface of the thigh, placed in the radical cavity and packed in place.

The gross specimen is seen in figure 1. Microscopic examination of the excised tissue revealed cholesteatoma, as demonstrated in figure 2, a section of the wall of the cyst. One can see the

subepithelial layer of connective tissue supporting a layer of stratified squamous epithelium, the surface of which contains eleidin granules and is desquamating into the center of the cyst.

CASE 2.—A boy aged 10 presented himself with the complaint of a discharging left ear. His mother stated that from the ages of 3 to 7 years he had been troubled with severe headaches, which were relieved by vomiting. His last headache was followed by a spontaneous discharge from the left ear, and the discharge had been persistent ever since. There was no history of vertigo. His tonsils had been removed three years previously.

On examination, the left aural canal was found to be full of a very foul-smelling purulent discharge. The tympanic membrane was absent. Cholesteatomatous material was hanging down from the attic into the middle ear. There was an attic defect, from which cholesteatomatous material could be pulled with a cerumen hook. Results of the rest of the ear, nose and throat examination were essentially negative.

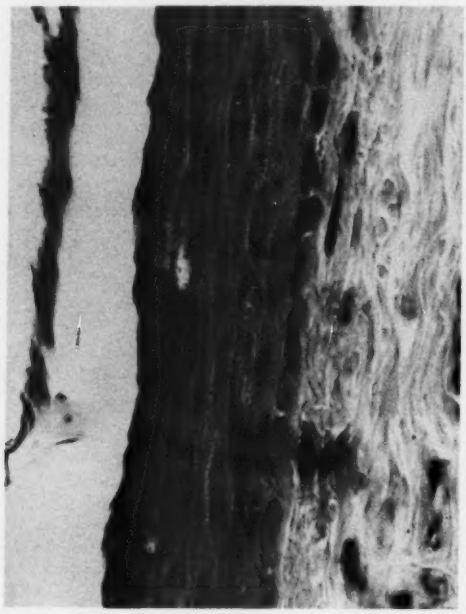

Fig. 2 (case 2).—Section of the wall of an external cholesteatomatous cyst. (Hematoxylin and eosin stain; × 1,000.)

The general physical examination disclosed that the patient was underweight and that there was a congenital depression of the lower third portion of the sternum. A roentgenogram of the thorax, the urinalysis, serologic procedures and a tuberculin test contributed nothing of moment. A hemoglobin determination and a leukocyte count were within normal limits. Roentgenograms of the mastoid processes did not reveal any evidence of a pathological process.

A diagnosis of "chronic suppurative otitis media, type 3, with mastoiditis and cholesteatoma" was made. Attic irrigations with a solution of boric acid in 95 per cent alcohol were done over a two week period.

Since there was no improvement with local treatment, combined complete and radical mastoidectomy was performed via a postauricular approach. The bony mastoid was found to be extensively diseased and necrotic. Complete exenteration was found to be necessary, in addition to the radical operation and the removal of the cholesteatoma. The cholesteatoma was found to have occupied the mastoid antrum and the middle ear; to have created a cavity in the pyramid

between the horizontal and superior canals, and to have invaded the first part of the eustachian tube. The cholesteatomatous matrix was dissected off the promontory down to the eustachian tube. A plastic flap was cut and sewn into place, and a large rubber tube was placed in the external auditory canal to maintain patency and to afford drainage.

The patient was dismissed with the radical cavity in good condition. He had no difficulty until four years later, at which time he noticed a swelling of the postauricular area on the left. His local physician punctured the area and aspirated a large quantity of milky fluid. Aspiration was done again three months later. The swelling reappeared, however, and two months after the last aspiration he presented himself at the clinic.

On examination, the radical cavity was seen to be completely epithelized. There was a soft, fluctuant swelling extending along the mastoidectomy scar. There was no pain or tenderness. Roentgenograms of the mastoid processes showed only an operative defect on the left. The

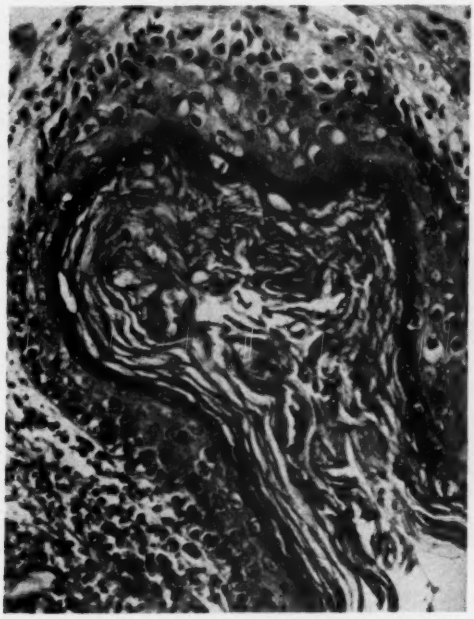

Fig. 3.—Section of an evagination in a cholesteatomatous matrix, illustrating the probable origin of a cholesteatomatous cyst. (Hematoxylin and eosin stain; × 285.)

swelling was punctured, and a quantity of milky fluid was aspirated. This fluid proved to contain sebaceous material and many cholesterol crystals. Culture of the fluid did not produce bacteria.

A diagnosis of an "inclusion cyst of the postauricular wound and the radical mastoidectomy cavity" was made. Advice that the cyst be removed was accepted. Two cubic centimeters of a 1 per cent solution of methylrosaniline chloride was injected into the cyst. Exposure was made via a postauricular incision. The cyst was dissected up from the subcutaneous layer and was found to be connected with the radical cavity. This cavity was lined with what appeared to be cholesteatomatous matrix. When this material was curetted out, a pea-sized cyst was discovered in the lining membrane in the area of the tegmen anterosuperiorly. Cholesteatomatous material was removed from an extension toward the apex, and the remainder of the lining membrane was thoroughly curetted out. A plastic flap was cut, and the ear was packed with petrolatum gauze.

Microscopic examination of the excised tissue disclosed a cholesteatomatous cyst. The patient was dismissed with the radical cavity in good condition. He was seen three months later, at which time the cavity was found to be in good condition. It was filling with dense scar tissue.

COMMENT

The cysts described here apparently resulted from a remaining cholesteatomatous matrix, which formed an evagination, continued to desquamate, enlarged, and expanded in the path of least resistance, which was through the soft tissues into the postauricular subcutaneous tissue. Figure 3 demonstrates such an evagination in a cholesteatomatous matrix removed in another case. The subepithelial layer of vascular and connective tissue and the surface layer of stratified squamous epithelium exfoliating into the center of the evagination can be seen. It is easy to visualize how such a "pocket" might expand as a result of continued desquamation and enlarge at the expense of the adjacent soft tissue, forming a cystlike mass. The pea-sized cyst discovered in the tegmen area in case 2 was felt to have represented such a cyst in an early stage and to have had an origin similar to that of the postauricular cyst.

In opposition to the theory of Tumarkin,[14] the lining of a cholesteatoma has been demonstrated to be true stratified squamous epithelium.[15] Nevertheless, when it is preserved as an epithelial lining, its behavior is different from that of a skin graft utilized to line a tympanomastoid cavity. Whereas the cholesteatomatous matrix may force itself into the haversian canals of bone, form folds and convolutions and persist in an eczematoid reaction to irritation, a skin graft presents fewer of these potential complications. In certain instances, on the other hand, it has seemed that the eventual result is better when skin grafting is not used, because of occasional tendencies in the grafted skin for an eczematoid reaction to develop. It is felt that had the cholesteatomatous matrix been completely removed at the first operation in the cases we have presented, there would have been no formation of cysts and no necessity for secondary surgical procedures.

To be considered in the differential diagnosis of these lesions are meningoceles, sebaceous cysts, cystic hygromas, lymphomas and fibromas. Needle aspiration of the postauricular enlargement and examination of the aspirated contents may be deemed advisable as a preliminary step in establishment of a diagnosis.

SUMMARY

Two cases are reported of external cholesteatomatous cysts of the mastoid that developed subsequent to radical operations for the removal of aural cholesteatomas. It is postulated that these lesions developed from remaining cholesteatomatous matrices. Thorough removal of the cholesteatomatous matrix is advocated in the surgical treatment of aural cholesteatomas.

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RADIOCOBALT IN OTOLARYNGOLOGY

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SAN FRANCISCO

THE PURPOSE of this paper is to direct attention to radiocobalt as a source of gamma radiation. When compared with radium as a source of gamma radiation, radiocobalt has these advantages: availability, ease of handling, high energy gamma rays and a price range that is not prohibitive.

My initial interest in obtaining a source of gamma radiation other than radium did not arise from altruism, nor did it arise from some smatterings of knowledge of the principles of nuclear physics that I had been forced to acquire in order to remain conversant with those who were responsible for radiation therapy. My interest was the direct result of my being annoyed. Prior to 1940 and the dismantling of the local equipment for the production of radon seeds, there was a readily available and seemingly inexhaustible supply of radium. The abrupt elimination of this adequate and most comfortable source imposed the necessity of seeking substitute sources of supply. One practically queued up to use the available radium, which was then in great demand. By the middle of 1946 the annoyance factor was so great and the tolerance factor so threadbare that direct action of some sort was imperative. The problem and a partial solution was presented to Dr. Bertram V. A. Low-Beer, who is in charge of radiation therapy at the University of California Medical School. His response was enthusiastic and was more so after he returned from a meeting in Chicago in December of that year, when he had an opportunity to discuss the problem with Dr. Paul C. Aebersold, chief of the Isotopes Branch, Research Division, Oak Ridge, Tenn. After some correspondence and a fruitless endeavor on my part to verify a rumor that there was a long half-life isotope of tantalum other than the 97 day Ta 182,[1] we received a letter from Dr. Aebersold, dated March 14, 1947, that read, in part, as follows:

> A wire made by the Wilbur B. Driver Company, Newark, N. J., seems ideally suited to your purpose. It is called Cobanic. It has a diameter of ⅛ inch (3.17 mm.) and is an alloy of 54.5 per cent nickel, 44.5 per cent cobalt and 1 per cent iron. Nickel has no beta or gamma activity, and the radiation from the iron would be inconsequential. If the beta radiation or the chemical composition of cobalt wire is objectionable, the wire could be sealed into a tube or bulb of gold or platinum after irradiation. The amount of cobalt, and hence the size of the cartridge, can be decreased by irradiating Co^{60} to a higher specific activity. It is possible to increase this activity to the order of 300 to 500 mc./Gm. by a special irradiation service over several months' time.

From the Department of Otorhinolaryngology, Division of Surgery, University of California Medical School.

Read before the Section on Laryngology, Otology and Rhinology at the Ninety-Ninth Annual Session of the American Medical Association, San Francisco, June 28, 1950.

1. Seaborg, G. T.: Artificial Radioactivity, Chem. Rev. **27**:199 (Aug.) 1940.

The idea of using an alloy did not appeal to me. The article by Myers [2] had not been published; so we were not able to profit by his experience with the difficulties in machining pure cobalt rondels. A local fabricator of rare metals, Mr. Park B. Hyde, of the Park B. Hyde Company, San Leandro, Calif., was interested in the project and agreed to manufacture beads of cobalt, as described in portions of a letter.

> The beads are made from cobalt sold by the General Chemical Company and claimed to be 98 to 99 per cent pure. During fabrication there may have been some small amount of impurities added, such as iron, through contact with grinding fixtures, and aluminum oxide, which is the principal component of the grinding wheel. Most of these beads are made from a swedged cobalt rod, but a few of them were made from cobalt which was melted in a carbon crucible, and in the crucible there may have been a carbon contamination, the amount of which we have not determined. We believe that, with the exception of those beads which may contain carbon, there was no appreciable contamination in fabrication. If you wish to secure the contaminating elements in the cobalt which we used, you can probably secure an analysis from the General Chemical Co., of New York City, by referring to lot 1453.6.
>
> [signed] Park B. Hyde Co.

The letter fails to mention that he ruined five dozen high-speed carbon drills in boring the 0.5 mm. hole through the beads. The commission presented a challenge. He was most cooperative and financially lenient.

The metal cobalt was selected because it offered more advantages than any other available radioactive isotope. Whatever egotistic delight I enjoyed as the result of thinking I had a part in contributing something new, or contributing even plans for something new, was completely eliminated after a discussion of the subject in June of 1947. I was informed that any fool could go through Seaborg's tables [1] showing the characteristics of the available isotopes and come to the same conclusions. I was further informed that the possibilities and potentialities of radiocobalt had been thoroughly discussed as early as 1942. Actually, the potentialities of radiocobalt were realized in the middle 1930's after the production of this isotope by the bombardment of the metal cobalt with high speed deuterons or with a beam of neutrons produced by the cyclotron. The limited amount of material produced in this manner was sufficient for identification and classification of its characteristics but did not permit more than speculation concerning its practical value as a source of gamma radiation. The establishment of the pile at Oak Ridge offered the opportunity for mass production. The fact that this information had not been published and was still common knowledge to only the few within the better informed circle was quite beside the point. Being properly deflated, but not altogether humble, I returned to Dr. Low-Beer for counsel and aid. He was generous with both.

The element cobalt was discovered and described by Brandt in 1735. The name cobalt is derived from the German word *Kobold*, meaning goblin. It acquired its name because its ores, being mistaken for those of copper and iron, did not yield the expected metals after smelting. The failure to obtain iron or copper from the likely appearing ores was attributed to the influence or work of a demon or goblin.

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2. Myers, W. G.: Radioactive Needles Containing Cobalt^{60}, Science **107**:621 (June 11) 1948.

Cobalt is a metallic element, similar in many respects to iron and nickel. It is silvery white, weakly magnetic and retains this magnetic property even when brought to a red heat. Some of its descriptive characteristics are as follows: symbol, Co; atomic number, 27; atomic weight, 58.94; valence, 2 and 3; density, 8.71 Gm. per cubic centimeter at 21 C.; melting point, 1,480 C. and boiling point, 3,000 C.

The element seldom occurs by itself in nature. Meteorites frequently contain a high per cent of the pure metal. It is found in the mineral cobaltite in combination with sulfur and arsenic and smaltite, which also contains arsenic, nickel and iron and other ores containing manganese, iron, nickel, sulfur and arsenic. The pure metal is produced by the Goldschmidt process. This method uses the reducing action of aluminum, carbon or hydrogen. For a long time the metal had little or no commercial use or value. The advent of the use of alloys brought cobalt to the fore as an important metal in the production of high-speed steels and for the cutting edges and surfaces of hard cutting tools.

The element is chemically active, as is shown by the large series of cobaltous and cobaltic salts and the extremely complex cobalt amines, which are derived from the combination of ammonia and the cobaltic salts. Cobaltous chloride, commonly known as invisible ink, is almost colorless in dilute solution. The writing becomes quite legible when the paper is heated and the water of crystalization is driven off. Conversely, when the heat is removed and the salt regains a water molecule it again becomes colorless and the writing disappears. This procedure can be repeated any number of times. Cobalt yellow, green and blue are pigments of high quality.

One cannot resist recounting a bit of the historical background of cobalt. Hobson,[3] one of the authorities on Chinese ceramics, adds to the beautiful illustrations a descriptive, detailed word picture of the selected examples of the characteristic ceramics of the Ming Dynasty (1368 to 1644 A.D.). The volume is studded with mention of the pigment "Mohammedan blue," which, when fired, produced that blue so precious to the collector. The quality of the blue color was dependent on the per cent and purity of the cobalt in the cobaltiferous ores of manganese, found either naturally or obtained as the result of patient refinement of the impure ores that were used for ornamentation. The exact source of the pigment is still open to question. It is the same blue as was used by the potters in Persia and the Near East in the ninth century A.D. Burton [4] points out that there were deposits of the purest cobalt ore in Baluchistan, India. This statement was confirmed by Hirth and Rockhill,[5] who, in going over the annals of Chinese trade during the Sung Dynasty (960 to 1279 A.D.), mention that cobalt blue came from Ghazin on the northwest borders of India.

It is not permissible to continue with this phase of the subject. However, should it so happen that interest has been aroused, I can assure the reader that the literature on this period is filled with facts that are both exciting and informative.

3. Hobson, R. L.: The Wares of the Ming Dynasty, New York, Charles Scribner's Sons, 1923.

4. Burton, W.: General History of Porcelain, New York, Funk & Wagnalls Company, 1921, p. 68.

5. Hirth, F., and Rockhill, W. W.: Chau-Ju-Kua, New York, G. E. Stechert & Company, 1913, p. 138.

Cobalt is a gray-white metal which, unlike iron, does not tarnish easily. It does not react with body fluids. Animal experiments with the soluble salts show a rapid excretion and only a slight deposition in the tissues. The exact metabolic role is not understood. Distribution of the element is general throughout the tissues, except under experimental conditions in which large quantities are injected. Under these conditions the liver is the chief storage organ, from which 46 per cent of the amount administered was recovered. Solutions of radiocobalt behaved in a similar manner. Within a few days 65 per cent was excreted in the urine and the remaining 35 per cent in the feces. It is evident that small quantities are essential for normal metabolism. The so-called "bush disease" of cattle in parts of Austrialia and the failure of cattle to prosper in the lush pastures of Florida have been attributed to the absence of cobalt. The addition of this element has permitted Florida to become an important cattle-raising state.

The advantages cobalt has to offer can be divided into two categories, those prior to activation and those following activation.

The advantages prior to activation are as follows:

1. There is an adequate, available and inexpensive supply of the metal.

2. This available supply is relatively free of contaminants. It consists of 98.9 per cent metallic cobalt and 1.1 per cent contaminants in the form of iron, nickel and sulfur. None of these produce any radioactive contamination that is detrimental.

3. The metal can be fabricated into any form or shape, either by direct mechanical means or by indirect methods, such as electroplating. The hexagonal crystalline structure of the metal at ordinary temperatures imposes many difficulties in working the metal cold. According to a recent publication,[6] Myers is reported to be preparing needles of pure cobalt.

4. The ability to fabricate the metal into the desired forms and shapes while it is radioinactive eliminates all the industrial hazards associated with handling radioactive materials.

The advantages following activation are, essentially, shown in a comparison of the properties of radiocobalt and radium as agents for external and interstitial gamma radiation therapy. They are as follows:

1. The gamma radiation from radiocobalt is monochromatic, almost homogeneous, and has a mean energy of 1.2 mev.

2. The beta radiation is only 4 per cent of the total energy emission and is of a low energy value of 0.3 mev. A layer of silver plate 0.08 to 0.16 mm. afforded complete elimination of the beta radiation.

3. There is no opportunity for contamination by gaseous daughter products. Radiocobalt decays into a stable solid element.

4. Radiocobalt from the neutron reactor is available in any desired quantity.

5. The size and weight factor can be diminished by using cobalt of a higher specific activity. This is obtained by means of a special irradiation service, with a resulting activity of 300 to 500 mc./Gm. in comparison with the 30 mc./Gm. obtained by normal irradiation times.

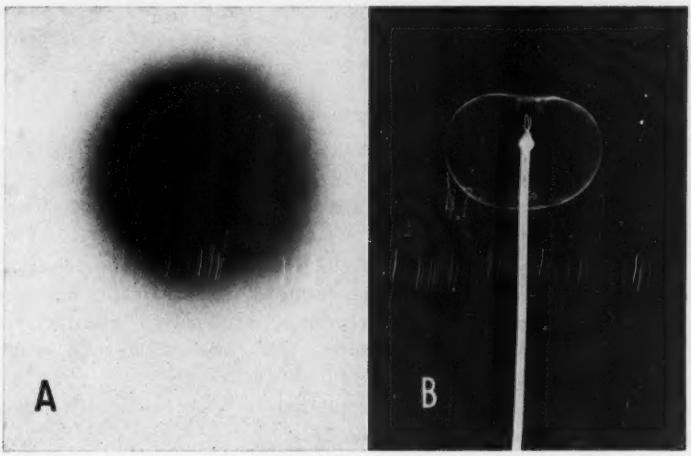
6. Cobalt Treats Cancer, Science News Letter **56**:371 (Dec. 10) 1949.

6. Any radiocobalt that might in any way accidentally enter the body can be rapidly eliminated.

7. It is a source of material with all the aforementioned characteristics at a price range that will not prohibit its use by any qualified individual person or institution.

When compared with radium as a source of gamma radiation, radiocobalt has only one disadvantage, and that is the relative short half-life of 5.3 years.

The present supply of radiocobalt consists of six 3.0 mm. and six 6.0 mm. beads. The smaller beads were activated to energies ranging from 0.6 to 6.0 mc./Gm. and the larger beads from 10.0 to 20.0 mc./Gm. This variation permits selection of a bead of suitable strength for the particular area to be treated. The intimate details relative to dosage which are dependent on disintegration rate, time and distance factors are available in Low-Beer's recently published text.[7]



A, autoradiograph made by cobalt bead. The even and regular distribution of the gamma radiation is graphically portrayed. *B*, roentgenogram of Foley catheter containing a cobalt bead.

Beads of the 98.9 per cent metallic cobalt were procured rather than needles or tubes. This choice of shape evolved from the desire for a point source of radiation and the fact that the areas selected for treatment would be body cavities. A Foley catheter with the tip cut off is an ideal applicator. The availability of these catheters in sizes from 5 to 70 cc. capacity permits the selection of one of the proper size for the particular cavity area and offers assurance that the radiation source will remain fixed in position. The inflatable cuff keeps the radiocobalt from touching any of the walls of the cavity (fig.). The deflated catheter containing the radiocobalt bead is inserted into the cavity and then inflated with either an iodide solution or one stained with methylene blue. The amount of fluid used determines the distance between the bead and the cavity wall. One is then in a position to

7. Low-Beer, B. V. A.: The Clinical Use of Radioactive Isotopes, American Lecture Series no. 54; American Lectures in Radiation Therapy, Springfield, Ill., Charles C Thomas, Publisher, 1950.

calculate the time required to obtain the desired dose. This method has been used in treating 11 patients with radiosensitive malignant neoplasm of the maxillary sinus, nasal septum and nasopharynx. Low-Beer and Schulte have used a similar technic for treating one patient with recurrent papillomatosis of the bladder.

The initial local reactions are the same as those obtained after exposure to similar doses of radium. The period of observation is much too short to warrant any evaluation of the results. Present knowledge permits the conclusion that the gamma radiation from radiocobalt is similar to that from radium, and therefore results may be anticipated similar to those obtained with use of radium. If this observation proves to be true, there is no reason why radiocobalt cannot be used in place of the usual radium applicator. The several advantages radiocobalt offers would suggest its use in preference to radium. Owing to the fact that radiocobalt emits gamma rays of high intensity, the same precautionary measures for handling, use and storage that apply to radium must be instituted and followed in order to protect the patient and the personnel.

CONCLUSIONS

1. Radiocobalt is an effective, efficient, inexpensive source of gamma radiation.

2. The metal cobalt is cheap and can be fabricated into any desired shape or form prior to activation, thereby eliminating any industrial hazard of working with a radioactive material.

3. Radiocobalt not only compares favorably with radium as a source of gamma radiation but has the advantage of producing a monochromatic, homogeneous radiation of high intensity that is accompanied with only a small per cent of relatively weak, unwanted beta radiation. This beta radiation is completely screened by silver plating to a thickness of 0.08 to 0.16 mm.

4. The production of radiocobalt in the form of beads has the advantage of a closer approach to a "point source" of radiation.

5. The use of a Foley catheter as an applicator in body cavities permits the centering of the radiocobalt bead and the assurance that it will remain in place.

6. Radiocobalt has no particular affinity for body tissues and is rapidly eliminated and therefore it does not present the same hazard as radium should it or its salts in any way accidentally gain entrance to the body fluids.

7. The relatively short half-life of 5.3 years is the only disadvantage radiocobalt presents when compared with radium as a source of gamma radiation.

490 Post Street.

ABSTRACT OF DISCUSSION

DR. B. V. A. LOW-BEER, San Francisco: It gives me great pleasure to pay tribute to Dr. Morrison's interest in and knowledge of radiological problems. Radiocobalt has been called the "poor man's radium." If this term connotes any disadvantage it is certainly a misnomer. Radiocobalt is in many respects preferable to radium because of its radiation characteristics. Radiocobalt emits higher energy gamma rays than do the disintegration products of radium. Radiocobalt gives a higher dose rate than equivalent amounts of radium. One millicurie equivalent Co^{60} delivers approximately 13 r at 1 cm. per hour, whereas the dose rate from 1 mg. of radium or 1 mc. of radon filtered with 0.5 mm. platinum is 8.4 r at 1 cm. per hour; 1 mc. equiva-

lent Co^{60} is equivalent to approximately 1.4 mg. radium. The fact the Co^{60} has a half-life of only 5.3 years compared with the half-life of radium, which is 1,600 years, is not at all a complicating factor in dosage calculation. Co^{60} disintegrates at a rate of 1.01 per cent per month. Decay tables and correction factors are available for calculation. A question may be raised whether cobalt beads, such as those described by Dr. Morrison, themselves absorb radiation to an appreciable degree. Self-absorption of cobalt, determined experimentally, amounts to only 0.34 per cent per cm. cobalt metal. The use of beads is unique in radiation therapy. Radium has always been prepared in the form of needles or tubes.

The same safety precautions must be observed in handling radiocobalt as those for handling radium. Radiocobalt must be stored in proper lead containers. Careless handling of radiocobalt results in the same damaging effects as those produced by radium.

Dr. Morrison has described the use of radiocobalt in the treatment of tumors of the maxillary sinus and nasopharynx. Besides these uses, radiocobalt has proved valuable in the treatment of urinary bladder tumors, and it should constitute an ideal radiation source for treatment of uterine body cancer. The use of radiocobalt at a distance from the patient for telecobalt therapy has great possibilities as a 1 mev monochromatic radiation beam unit. At the present, radiocobalt is used only in two medical centers, one at the University of Ohio and the other at the University of California.

TONSILLECTOMY AND ADENOIDECTOMY AND POLIOMYELITIS

ALDEN H. MILLER, M.D.
LOS ANGELES

MUCH CONTROVERSY in recent years has raged in the literature regarding the following questions: (1) Does a recent tonsillectomy and adenoidectomy increase the danger of the patient's contracting poliomyelitis? (2) If poliomyelitis has been contracted does a recent preceding tonsillectomy and adenoidectomy increase the danger that the bulbar type of the disease will develop? (3) Should tonsillectomies and adenoidectomies be discontinued during the summer months of highest poliomyelitis incidence?

The greatest incidence of poliomyelitis in this nation occurred in 1949 when 42,375 persons were stricken. Los Angeles County, formerly the scene of some of the nation's largest epidemics, recorded 1,229 cases of this disease (the third highest total in its history) during 1949. Follow-up observations in the home and complete statistical data were obtained in all cases by the Los Angeles County and the Los Angeles City Health Departments. This complete information regarding an entire year's incidence in a county of a large population in which a large number of poliomyelitis cases occurred justifies this additional attempt to answer the three questions posed.

DOES A RECENT TONSILLECTOMY AND ADENOIDECTOMY INCREASE THE RISK OF POLIOMYELITIS DEVELOPING?

The usual incubation period of poliomyelitis averages 10 to 14 days, but the condition has occurred as early as four days and as late as three weeks after known exposure. Most workers believe that if the nasopharynx which has been surgically traumatized by tonsillectomy and adenoidectomy is to be the portal of entry, the virus must be present in the nasopharynx at the time of the operation. Most general pathologists believe that by the end of the first 24 hours after a tonsillectomy and adenoidectomy, local tissue reaction has developed which would prevent the successful invasion by most pathogenic organisms. Unlike bacteria, however, the poliomyelitic virus is believed to travel in and along the nerves. For these reasons almost all writers consider the period of 30 days following tonsillectomy and adenoidectomy to be of significance if there is to be any relationship between this operation and the causation of poliomyelitis.

Read before the Section on Laryngology, Otology and Rhinology at the Ninety-Ninth Annual Session of the American Medical Association, San Francisco, June 29, 1950.

From the University of Southern California School of Medicine and the Communicable Disease and Otolaryngological Services of the Los Angeles County General Hospital.

Follow-up observations in all the 1,229 cases of poliomyelitis reported in the County of Los Angeles by the County and the City Health Departments reveal that only five of the patients had had a tonsillectomy and adenoidectomy during the 30 day period in which their poliomyelitis symptoms started. In table 1 is a summary of the data on these five patients.

This number, five, is considered quite insignificant. The actual incidence of poliomyelitis in the population undergoing a tonsillectomy and adenoidectomy in 1949 can be compared with the expected incidence of poliomyelitis in the same age group of the population. This comparison could be made only on a city-wide basis, since a reasonably accurate account of tonsillectomies and adenoidectomies performed in 1949 could be obtained only from city sources. The expected incidence was determined by dividing the child population of Los Angeles at the ages when nearly all tonsillectomies and adenoidectomies are done by the number of cases of poliomyelitis

TABLE 1.—*Summary of Data on Five Patients*

File Number	Age in Years	Onset of Poliomyelitis (1949)	Tonsillectomy and Adenoidectomy Previous to Onset by Days	Type of Poliomyelitis	Result
Cases of Poliomyelitis in Los Angeles City					
155-251	6	July 2	7	Bulbar	Recovery with slight residual paralysis of face and in swallowing
1143-145	8	October 1	15	Paralytic	Recovery with slight residual paralysis of the right leg
Cases of Poliomyelitis in Los Angeles County Outside the City					
1144-895	2	May 3	22	Bulbar (facial nerve only)	Death on fourth day
1164-450	4	August 18	13	Paralytic	Complete recovery
1168-260	2	September 15	30	Nonparalytic	Complete recovery

that developed in all children of this same age group in Los Angeles city during 1949.

Population.—In table 2 is a tabulation of the child population in Los Angeles city. The figures for the 2, 3 and 4 year old children were obtained by using the birth rate in the city for the years 1947, 1946 and 1945. The figures for the other yearly populations were obtained from the enrolment figures in the public and parochial elementary school grades, beginning with the kindergarten enrolment of the 5 year old children and the first grade enrolment of those aged 6, and so on. The age group of 2 to 8 years inclusive was taken as the one in which almost all tonsillectomies and adenoidectomies are performed. The population for this age group in Los Angeles city is 239,369.

In the second column of table 2, as obtained from the Los Angeles City Health Department, are listed by age the number of patients with poliomyelitis in the city. The total for the age group of 2 to 8 years inclusive was 177; 239,367 divided by 177 equals 1,352. In other words, there was one case of poliomyelitis per 1,352 of the tonsillectomy and adenoidectomy population.

Number of Tonsillectomies and Adenoidectomies Performed.—This figure was more difficult to obtain. Ten of the 31 major hospitals and clinics in Los Angeles

city were able to supply the number performed during 1949 on a monthly basis. Three others were able to supply this information on only a yearly basis. Table 3 shows that the total number of tonsillectomies and adenoidectomies was 7,406 in these 13 hospitals and clinics. Inasmuch as this total did not include those operations performed in the 18 other hospitals, those done in offices or those done

TABLE 2.—*Incidence of Poliomyelitis in Tonsillectomy and Adenoidectomy Age Population of Los Angeles City*

Age by Year	Child Population of Los Angeles City		Number of Cases of Poliomyelitis by Age of Patient		Number of Cases of Bulbar Poliomyelitis by Age of Patient	
1 and under	.....		33		4	
2	41,513		20		4	
3	37,481		29		6	
4	31,897		28		1	
5	29,160	Total 239,369	21	Total 177	2	Total 22
6	37,541		26		4	
7	32,590		32		3	
8	29,187		21		2	
9	27,023		17		3	
10	23,871		11		3	
11	22,497		13		3	
12 and over	.....		191		44	
			442		79	

239,367/177 = 1,352

Thus the actual incidence of poliomyelitis was one case per 1,352 of the tonsillectomy and adenoidectomy age population

TABLE 3.—*Number of Cases of Poliomyelitis in Los Angeles City in 1949 According to Month*

Month	Number
January	498
February	591
March	787
April	929
May	751
June	718
July	403
August	222
September	123
October	209
November	523
December	423
	6,177
Yearly total of 3 other hospitals	1,229
	7,406 × 2 = 14,812 Total for city

14,812/1,352 = 11, the incidence expected of poliomyelitis in patients who had a tonsillectomy and adenoidectomy in Los Angeles city in 1949.

in the many small hospitals, clinics and recovery clinics, it was decided to double this number. The resultant total, 14,812, appears to be reasonably accurate when compared with the figures given by other writers concerning the number of tonsillectomies done in one year in known populations. For instance, Kinney [1] stated that in 1947 there were 12,413 tonsillectomies and adenoidectomies performed in an Ohio county with a population of 1,400,000, or one tonsillectomy and adenoidectomy to each 113 of the population. As the population of Los Angeles city is

1. Kinney, C. E.: Tonsillectomy and Poliomyelitis in Cuyahoga County, Ohio, Ohio State M. J. **44**:1215 (Dec.) 1948.

2,008,069, the total of 14,812 would represent one tonsillectomy and adenoidectomy being performed in Los Angeles city in 1949 to each 135 of the population. Lederer and Grossman's [2] estimate that 2,000,000 of the United States' population of 150,000,000 (or 1 to 75) have a tonsillectomy performed each year demonstrates that the figure 14,812 is probably much too conservative.

When the expected ratio of one case of poliomyelitis per 1,352 of the population is applied to this tonsillectomized population of 14,812, (14,812 divided by 1,352) it is found that the expected number of cases of poliomyelitis in the patients who had a tonsillectomy and adenoidectomy in 1949 is 11. How does this expected figure compare with the total number of cases of poliomyelitis that actually occurred in Los Angeles city in patients who had had a tonsillectomy and adenoidectomy that year? Inasmuch as the figure of 2 cases of poliomyelitis, given in table 1,

TABLE 4.—*Incidence of Poliomyelitis in Los Angeles County During 1949 in Patients Who Had Had a Tonsillectomy and Adenoidectomy During That Year*

	Number of Months					
Period between tonsillectomy and adenoidectomy and onset of poliomyelitis	1 or Less	2	3	4	5	6 or More
	5	3	3	3	4	3

Month of Onset	Number of Recent Tonsillectomies and Adenoidectomies		Cases of Bulbar Poliomyelitis		Total Number of Tonsillectomies and Adenoidectomies		Cases of Bulbar Poliomyelitis	
April	1		1		1*		1*	
May	..		..		0		..	
June	1		1		3		1	
July	..		..		1		1	
August	2	3	..	0	4	14	..	2
September	1		0		6		..	
October	..		..		3		1	
November	..		..		3		..	
December	..		..		0		..	
	5		2		21		4	

21/2 = 10.5, the actual number of cases of poliomyelitis in patients who had a tonsillectomy and adenoidectomy in Los Angeles city in 1949.

* Only death.

occurred in only those patients who had had a tonsillectomy 30 days or less before the onset of poliomyelitis symptoms, it was necessary to use the larger figures for the total county. The figures of the county health department, in addition to those of the city health department, showed that there was an incidence of poliomyelitis in 1949 in 21 children who had had a tonsillectomy and adenoidectomy at some time during that year. (It was of interest that twice as many of these children had had tooth extractions during the year.)

Table 4 lists both the month of onset of the poliomyelitis and the time that intervened between the date of operation and the onset of poliomyelitis symptoms. Inasmuch as the county's population is 4,006,543, while that of the city is 2,000,869, or half as much, it is considered that the actual incidence of poliomyelitis in the city population that had had tonsillectomies and adenoidectomies that year was 21 : 2, or 10.5. The difference between the figure 10.5 and the estimated figure of

2. Lederer, F. L., and Grossman, A. A.: The Otolaryngologist Looks at the Tonsil and Adenoid Problem, Eye, Ear, Nose and Throat Monthly **28**:577 (Dec.) 1949.

11 is of no significance, and it was concluded, therefore, that the tonsillectomies and adenoidectomies performed in 1949 in the age group of 2 to 8 years had no effect on the incidence of poliomyelitis in that same age group.

Statistical Analysis.—It was next decided to submit the above data to a statistician in one of the health departments for a measurement of the significance of the deviation between the expected and the actual incidence of poliomyelitis in

TABLE 5.—*Number of Cases of Poliomyelitis in Los Angeles City in 1949 According to Month of Onset*

Month	Number
January	18
February	4
March	7
April	3
May	14
June	26
July	70
August	75
September	97
October	62
November	45
December	21
Total	442

TABLE 6.—*Statistical Significance of Variation Between Expected and Actual Number of Cases of Poliomyelitis Among Patients Who Had Tonsillectomy and Adenoidectomy*

Period	Expected Number of Cases of Poliomyelitis and Tonsillectomies and Adenoidectomies	Actual Number of Cases of Poliomyelitis and Tonsillectomies and Adenoidectomies	Chi Square
Entire year of 1949	11.0	10	0.97
February to November (10 months)	8.4	10	0.31
April to November (8 months)	6.2	10	3.30
May to October (6 months)	3.6	8	5.51
July to October (4 months)	1.4	7	22.66
July to October (4 months)	1.4	1.5 within 30 days of onset	0.007

* 0.01 = 6.63

* 0.01 is the significant point at 1 per cent level of confidence.

Statistician's Report.—"The only period in 1949 in Los Angeles city to exhibit a significant difference between the occurrence of poliomyelitis and a tonsillectomy and adenoidectomy and poliomyelitis and no tonsillectomy and adenoidectomy is that of July through October, the months of highest incidence.

"Within this period no significant difference is found between the occurrence of poliomyelitis and no tonsillectomy and adenoidectomy and tonsillectomies and adenoidectomies within only one month of poliomyelitis onset."

the patients who had undergone tonsillectomy and adenoidectomy in 1949. Knowing that some writers have maintained that such a statistical study should be done only with the cases occurring in the summer months of highest poliomyelitis incidence and smallest number of tonsillectomy and adenoidectomy operations, the statistician was asked to make his study on the basis of the 10 month, 8 month, 6 month and 4 month period of highest incidence as well as on the yearly basis, despite the fact that table 5 shows that a high incidence of poliomyelitis was maintained for a six month period in Los Angeles city in 1949.

In table 6, the statistician's report, it is noted that there was no significant variation between expected and actual cases of poliomyelitis in patients undergoing

tonsillectomy and adenoidectomy until the four month period of July through October was considered. Here, the incidence of seven cases occurring in the city (14 in the county) during those four months in patients who had had tonsillectomy and adenoidectomy at some time that year seemed significant. This one finding might be considered to lend some support to the contention of those who hold that there may be a positive correlation between the absence of nasopharyngeal lymphoid tissue and the incidence of poliomyelitis. However, of the 14 cases of poliomyelitis (county-wide) in the four month period of July through October, only three occurred in patients who had undergone tonsillectomy and adenoidectomy in the 30 days preceding the onset of their symptoms (table 4). When half of this number, one and a half, the city-wide equivalent, was analyzed by the statistician, the very insignificant chi square figure of 0.007 was obtained. Thus, mathematically there was no significant variation between the expected and the actual incidence of poliomyelitis in those patients who had had a recent tonsillectomy and adenoidectomy even in this four month summer period of highest poliomyelitis incidence.

IF POLIOMYELITIS HAS BEEN CONTRACTED DOES A RECENT PRECEDING TONSILLECTOMY AND ADENOIDECTOMY INCREASE THE DANGER THAT THE BULBAR TYPE OF THE DISEASE WILL DEVELOP?

During 1949, of the poliomyelitis cases in Los Angeles County, 18.6 per cent were reported as being of the bulbar type. Of the five cases reported in the opening of this paper in which a tonsillectomy and adenoidectomy had been performed within the 30 days preceding the onset of the symptoms, the poliomyelitis in two was reported as being of the bulbar type. This observation would give a figure of 40 per cent. However, attention is again directed to these five cases in table 1. It will be noted that in one of the two cases there was involvement of only the seventh nerve, while in the other case the ninth and tenth cranial nerves were involved. Cranial nerves that may be involved in bulbar poliomyelitis include the fifth, ninth, tenth, eleventh and twelfth. Most neuropathologists believe that if the traumatized nasopharynx is to afford more than ordinarily easy access of the virus to the bulb the virus must extend along one of the nearby cranial nerves, such as the ninth or tenth. Therefore, if the case with involvement of the seventh nerve only is not considered as being of significance in determining whether bulbar poliomyelitis is more likely to develop in the recently tonsillectomized patient, it is then noted that only one case of the five (or 20 per cent) can be so considered. When the whole year's total of 21 cases of poliomyelitis in which a tonsillectomy and adenoidectomy had been performed at some time during the year were investigated it was found that only an additional two were reported as being of the bulbar type. This total of four then represents an actual figure of 19.04 per cent. These actual figures of 20 per cent and 19 per cent do not vary significantly from the estimated 18.6 per cent. The statistician refused to consider this problem mathematically because the number of actual cases of bulbar poliomyelitis (two) that developed in the actual number of patients with poliomyelitis who had had a recent tonsillectomy and adenoidectomy (five) was too small to justify a statistical comparison and conclusion. The total of only two cases in which bulbar poliomyelitis developed out of 1,229 cases seems to indicate that there is a remote possibility that a recent tonsillectomy and adenoidectomy was a factor in the development of the bulbar type of this disease.

SHOULD TONSILLECTOMIES BE DISCONTINUED DURING THE SUMMER MONTHS OF HIGHEST POLIOMYELITIS INCIDENCE?

The conclusions reached in attempting to answer the first question indicates that the answer to this last question should, likewise, be "no," unless one happens to believe that tonsillectomy and adenoidectomy done any number of months before the onset of poliomyelitis could have been a factor in the development of that case of poliomyelitis. Certainly, the statistical analysis indicated that the three cases of poliomyelitis occurring during the notorious four months of July, August, September and October were not of mathematical significance in comparing actual and estimated values.

An attempt was made to determine how many of the patients with poliomyelitis during 1949 had had tonsillectomy and adenoidectomy at any time previously. Unfortunately, this question was accurately answered in only one third of the last 600 cases in 1949. This survey disclosed that 66.3 per cent, or two thirds, of the poliomyelitis patients had never had a tonsillectomy and adenoidectomy. The first impression gained from these figures might be that the nontonsillectomized patient has twice as great a chance of contracting poliomyelitis as has the tonsillectomized patient. Instead, though, the survey substantiates the contention of numerous writers that about one third of the general young population now has been tonsillectomized. Thus it would be expected that two thirds of all poliomyelitis patients have never had tonsillectomy or tonsillectomy and adenoidectomy prior to the onset of their disease.

SUMMARY AND CONCLUSIONS

A survey of the 1,229 cases of poliomyelitis occurring in Los Angeles County during the epidemic year 1949 has been presented in an attempt to determine whether there is any relationship between a recent tonsillectomy and adenoidectomy operation and (1) the incidence of poliomyelitis and (2) the development of bulbar poliomyelitis, as well as in an attempt to determine whether (3) tonsillectomies and adenoidectomies should be discontinued during the summer months of highest poliomyelitis incidence.

The results of the statistical analysis indicate no clinical or statistical significant deviation between the actual and the expected incidence of poliomyelitis developing in Los Angeles County during 1949 in patients recently tonsillectomized and adenoidectomized, even in the months of July through October. In view of these observations, there seems to me to have been no reason found to discontinue doing indicated tonsillectomies and adenoidectomies during the summer months.

500 South Lucas Avenue.

Dr. John Chapman, epidemiologist of the Los Angeles City Health Department, and Dr. Mary Dale, epidemiologist of the Los Angeles County Health Department, made available to me the complete data compiled by them and their departments.

ABSTRACT OF DISCUSSION

Dr. R. C. Martin, San Francisco: There are few instances in which normal expectancy figures have been established. Dr. Miller has done a tremendous amount of work in assembling these data. I am not a statistician, but I have checked his figures on point 1: "Does a recent tonsillectomy and adenoidectomy increase the danger of contracting poliomyelitis?" I cannot find that in this epidemic it does, even for the period of greatest incidence of poliomyelitis, July to October.

It is of interest to note that Kinney, of Cleveland, using similar methods, has answered point 1 similarly: "For both 1946 and 1947 in Cuyahoga County, Ohio, the number of children who contracted poliomyelitis after having had their tonsils and adenoids removed was less than normal expectancy."

Aycock and Luther in 1929 noted that the per cent of children with poliomyelitis who had had tonsillectomies and adenoidectomies is so near that of school children in general that whether or not adenotonsillectomy has recently been done does not seem to influence the occurrence of poliomyelitis.

The second point, "If poliomyelitis has been contracted does a recent tonsillectomy and adenoidectomy increase the danger that the bulbar type of the disease will develop? is answered in the negative. The figures show that for this epidemic of 1949 in Los Angeles, at least for the time and place, the danger of the bulbar form of poliomyelitis was not increased.

However, no one studying this problem has emphasized that the type of involvement in poliomyelitis varies in type and severity from one epidemic to another. In other epidemics in which the bulbar type showed a high incidence, the opposite has been shown, as might be expected.

Point 3 would seem to show for this epidemic that there was no reason to discontinue adenotonsillectomies during the summer months of highest incidence. The three cases of poliomyelitis in which a recent adenotonsillectomy had been done during the months of July, August, September and October were not of mathematical significance in comparing actual and estimated values.

The truth will be found by doing as careful statistical analysis along these lines of each epidemic. This procedure is now being attempted. The conclusion should not be based on emotion and hysteria, which has, unfortunately, been fostered by popular publications, usually headed by the caption, "The Truth about Tonsillectomies and Poliomyelitis."

I feel that to say arbitrarily that no elective surgical procedures should be done during the summer months is as unwarranted as was a procedure widely advocated some years ago, the use of zinc sulfate nasal therapy to prevent poliomyelitis.

I should qualify that statement of point 3 by stating that if there is a marked increase of traffic at any time, I omit elective driving. Likewise, in any time and place where there is an epidemic, I would not operate. Conversely in any time and place where there is no marked increase, I shall continue to operate.

DR. VICTOR GOODHILL, Los Angeles: The relationship between tonsillectomy and poliomyelitis is very important in the public mind. The widespread insistence that tonsillectomies and adenoidectomies are not to be done during the summer has produced serious reflections in the general population. Practically all parents in this country have been taught to dread this operation, not only during poliomyelitis epidemics but during the summer, fall and spring months.

Otolaryngology has been singularly involved in the poliomyelitis question for several reasons. The otolaryngologist is involved not only in the diagnostic aspects of the disease, because of the sore throat, headache and stiff neck, but he is being called in with increasing frequency for therapeutic assistance in the maintenance of the airway in patients with bulbar poliomyelitis.

The increased usage of tracheotomy in bulbar poliomyelitis has given the otolaryngologist intimate therapeutic contact with the problem of poliomyelitis. He has consequently become intimately conversant with the problem. Nevertheless, most laryngologists in contagious hospitals find it difficult to reconcile the widespread propaganda regarding poliomyelitis and tonsillectomy and adenoidectomy with statistical reality.

The publicity issued by various national organizations in regard to this question has not been based on accurate statistical data. A few dramatic family reports and certain numerically inconclusive surveys have been used as the basis for all the sensational publicity releases. Most public health officials are aware of the lack of statistical solidity in this field. Nevertheless, it has been necessary to advise curtailment of necessary adenotonsillectomy procedures simply to avoid censure by the lay public, which has been aroused by unwarranted sensational press propaganda.

Many children have been denied these necessary operations because of this propaganda, with consequent development of serious complications. Furthermore, it has now become necessary in most centers to concentrate huge case loads of these operations during the winter months, when epidemics of streptococcic and viral infections of the upper respiratory tract are rampant. Thus, many children are being subjected to known hazards in order to prevent a largely theoretical one.

Dr. Miller is to be commended for his courageous and painstaking study of this problem in the Los Angeles area. He has contributed an important chapter to the biology of poliomyelitis. It is to be hoped that he will continue further annual studies of this type. The welfare of the patient must be considered from a broad standpoint and not from the isolated standpoint of one disease.

DR. EDWARD J. LAMB, Santa Barbara, Calif.: As a pediatrician, I wish to thank Dr. Miller for the encouraging message he has given us to bring home to our patients.

In one of the discussions was mentioned the hysteria of parents regarding the possible complications of poliomyelitis following a tonsil and adenoid operation during the summer months, regardless of the presence or absence of the disease in the community at that time.

It may be recalled that similar hysteria prevailed 25 or more years ago regarding the possibility of a thymic death from anesthesia. Routine roentgenograms of the chest were taken at the time to dispel this fear. This procedure is seldom followed today.

To prevent the possibility of postoperative poliomyelitic infection, one must evaluate the individual child as a whole with regard to his physical, social and economic status before recommending nose and throat surgery during the summer months.

The child who is dehydrated, underweight, toxic and fatigued is a poor risk and more vulnerable and susceptible to virus of poliomyelitis. So, too, is the child who returns too soon postoperatively to an impoverished home with inadequate nourishment and nursing care.

Pediatrician and the surgeon jointly should consider the optimum time for selective surgical procedure on the individual child during the summer months.

DR. ARTHUR JONES, Boise, Idaho: Dr. Rosenhauer and I have been friends for many years. I met him the day before yesterday and he said, "We have found the Streptococcus that produces poliomyelitis." He has been working on that. He said, "We've got it!"

DR. JAMES P. LEAKE, Washington, D. C.: This subject, as the speaker and the discussers have stated, is controversial. In agreement with Dr. Lamb, I think that one should act with the full knowledge of what the public really deserves and not with regard to the fact that they are scared. Dr. Miller has shown, I think, the same results as those of other studies (I shall not cite the literature). I was glad, however, that Dr. Martin did mention the report of Dr. Anderson, from Utah. Numerous studies have been made, but it is difficult, however, to evaluate just how accurate each bit of information is. The accuracy of the data secured is very dubious, but the data do show, I think, that any incidence of poliomyelitis that might be increased by elective operation is very small.

I may, perhaps, take issue with the elimination of the second case of poliomyelitis mentioned by Dr. Miller because it was supposed to be from the seventh nerve. Considering that the condition was fatal, certainly more than the seventh nerve was involved.

CHAIRMAN: Dr. Harkness had an experience about 20 years ago, and I am sure there are many here who do not know about it. Would you mind relating it?

DR. GORDON HARKNESS, Davenport, Iowa: I cannot speak of it from the standpoint of statistical information, but about 25 years ago or more, there was a severe epidemic of poliomyelitis in our community. Dr. Resnow at that time felt that the anaerobic Streptococcus was responsible. He was at the Mayo Clinic, and he came to our community and spent six weeks there. It was a heyday for me in tonsillectomies because I was working quite closely with him and he did not think that there was any contraindications relative to tonsillectomies but, rather, was in favor of them. He asked me to take out the tonsils of all the patients who had possibly been in contact with the condition during the epidemic. I do not know how many tonsils I took out during that period, but, to my knowledge, there was not a single child for whom I removed the tonsils who contracted poliomyelitis, and the operation was done in the middle of an epidemic and was particularly directed toward those children who had had possible

contact with poliomyelitis. Perhaps this is not worth very much, but it does verify in my own mind the fact that this hysteria has carried one over beyond the point of reasonable, scientific deduction.

DR. ALDEN H. MILLER: I should like to thank all the discussers. They have added a great deal to this paper. I will now touch on some of the points they brought up.

In agreement with Dr. Martin, I, too, admit that the figures in the bulbar series are too small for me to feel as sure about my convictions here as I do about the larger over-all series. But just the fact that they are so small makes me believe that when we otolaryngologists do amass a sufficient number we shall still come up with the answer of "no" in the bulbar cases.

Now, as to his points about operations during a real epidemic, Yes, I agree with him, but I am going to ask that you do not let the newspapers, the Sunday supplement, the school nurse or some lay society tell you when there is a real epidemic. In other words, there is a big difference between a real epidemic and those months of high incidence during the summer, which as we all know, are to be expected in poliomyelitis. Rather, I am going to suggest that you decide that it is an epidemic when your health department or your own good common sense tells you that there is a real epidemic and not just the usual, expected, high summer month increase in incidence.

I should like to confirm most of the things Dr. Goodhill said, but being limited to just 15 minutes, this has to be a statistical presentation on my part. If I had had time for a discussion, I should have liked to present it as Dr. Goodhill did.

As to Dr. Leake's comment about the case with the seventh nerve involvement, many poliomyelitic patients die who do not have involvement of the bulb. On the subject of mortality I should like to ask you to remember the chart in whch I listed the 21 cases and in which there was an asterisk opposite one of the cases. Out of that total of 21 cases in the county with an adenotonsillectomy during 1949, there was only one death, and that was the death of the patient in whom the seventh nerve was involved.

Perhaps we are counting too many cases as being of the bulbar type. It was noted that in the official reporting of the bulbar cases the head of the contagious disease division at the County Hospital might have disagreed with some of these diagnoses of bulbar poliomyelitis. He felt this diagnosis should be reserved for those patients with specific involvement of the bulb as the primary site of the disease. There were many patients who needed tracheotomy or a respirator, and there were many patients who died, but in whom involvement of the bulb was not proved. Yet the condition in some was reported as being the bulbar type of poliomyelitis.

I am very happy to hear of Dr. Harkness' experience. It should be of aid in counteracting those first stories that seem to have started this whole controversy.

Finally, I could not close this paper unless I expressed my indebtedness to the two epidemiologists, Dr. John Chapman, of the City Health Department, and Dr. Mary Dale, of the Los Angeles County Health Department, for their splendid cooperation in making available the excellent and complete data which was compiled by them and their departments.

STRUCTURE AND FUNCTION OF THE LAMINA PROPRIA OF THE TYMPANIC MEMBRANE IN VARIOUS MAMMALS

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IT WAS shown by Fumagalli [1] that in man the bundles of collagenous fibers making up the lamina propria of the tympanic membrane are disposed in such a way that their tension does not change with increasing or decreasing tension of the tympanic membrane itself.

Investigations on man (Leonardelli,[2] Fumagalli,[1b] Filogamo [3]) have demonstrated, on the cone of radial bundles, a system of bundles (parabolic bundles) originating from the short process of the malleus. They fan out anteriorly and posteriorly, ending in the fibrous ring. They pass, stringlike, under the arch of the crescentic bundle. These two, the parabolic bundles and the crescentic bundle, form a morphological and functional unit, called by Fumagalli [1b] the "parabolic-crescentic system."

The fibers of this system relax when the long process of the malleus moves in the direction of the middle ear (stretching of the radial bundles) and extend when the handle of the malleus moves toward the external auditory canal (relaxation of the radial bundles). In consequence, the parabolic-crescentic system and the radial bundles are in a reciprocal balance. With different positions of the malleus, the degree of their bending will change, but not their tension. With retraction against the cavity, flattening out or bulging against the external canal of the tympanic membrane, as it would appear, its mechanical properties remain constant.

Fumagalli [1b] described an apparatus which, on the one hand, demonstrates that the mechanical properties remain unchanged, and, on the other, throws a light on a number of facts, as found recently by physiologists: Contraction of the tensor tympani does not change the acoustic qualities of the tympanic membrane (Luescher,[4] Troeger,[5] Geffken [6]); the acoustic qualities do not change with stretching of the

From the Department of Human Anatomy (Prof. A. C. Bruni) and the Department of Otolaryngology (Prof. L. Pietrantoni), University of Milano.

1. Fumagalli, Z.: (*a*) Contributo alla conoscenza della struttura della lamina propria della membrana del timpano umana, Arch. ital. di otol. **54**:211-224, 1942; (*b*) Ricerche morfologiche sull' apparato di transmissione del suono, ibid. (supp. 1) **60**:1-323, 1949.

2. Leonardelli, G. B.: Contributo alla conoscenza dei sistemi di fibre a parabola della lamina propria della membrana del timpano umana, Arch. ital. di otol. **1**:3-16, 1948.

3. Filogamo, G.: Recherches sur la structure de la membrane du tympan chez les différentes vertébrés, Acta Anat. **7**:118-136, 1949.

4. Luescher, E.: Experimentelle Trommelfellbelastungen und Luftleitungsaudiogramme mit allgemeinen Betrachtungen zur normalen und pathologischen Physiologie des Schallleitungsapparates, Arch. f. Ohren-, Nasen-u, Kehlkopfh. **146**:372-441, 1939.

5. Troeger, cited by Luescher.

6. Geffken, cited by Luescher.

tympanic membrane, either by increased air pressure in the external canal (Geffken [6]) or by loading of the malleus with drops of mercury (Luescher [4]).

Békésy,[7] in 1941, showed that the tympanic membrane vibrates as a rigid cone with sounds up to 2400 cycles per second around an axis passing through its upper edge. He remarked that a similar movement is possible only in case the tympanic membrane, like the membrane of a loud speaker, can vibrate in harmony with its margin; and this movement is possible because in the tympanic membrane may be detected, near its lower outline, where the movement is greatest, a very evident roundish fold, whose bending radius is limited between 0.5 and 0.8 mm. The great elastic power of this fold allows the conic portion of the membrane to be displaced without undergoing a strong deformation.

In many textbooks of anatomy, this fold does not appear in the illustrations. It seems that during the presence of disease and during anatomic preparation this portion of the membrane would lose its elasticity, so that the tympanic membrane stops functioning as a piston and also decreases the sound pressure to the handle of the malleus (Békésy [7]).

According to Fumagalli,[1] the fold mentioned by Békésy originates from the pressure exerted by the parabolic-crescentic bundle at the margin of the membrane; this pressure changes with the position of the manubrium.

It is clear that the fold, with vibration of the malleus, will appear smoother or sharper, independently of elastic fibers, as these fibers do not occur in the lamina propria of the tympanic membrane (Fumagalli [1]).

The investigations of Békésy, as well as those of Fumagalli, concern the tympanic membrane of man. Whether the same apparatus is present in the tympanic membrane of other mammals or whether their tympanic membrane vibrates according to the pattern described by Békésy for man is not known. It seemed useful to extend the study to various species of mammals with the aim of detecting or dismissing analogies with the conditions found in man by Fumagalli.[1b]

MATERIAL AND METHODS

Tympanic membranes, 10 of each, were studied in the following species: (1) Cavia cobaya; (2) Lepus cuniculus; (3) Canis familiaris; (4) Felis domestica; (5) Ovis aries; (6) Bos taurus; (7) Equus caballus, and (8) Sus crofa. The temporal bones, fixed in a 10 per cent formaldehyde solution, were decalcified in a 5 to 10 per cent solution of nitric acid. After decalcification, the external auditory canal was completely isolated to put the tympanic membrane in clear evidence.

For observation of the membrane from its surface, its peripheral connections were severed, with the aid of a large needle with a lance-formed point, and the malleus was removed with a pair of scissors without damage to the membrane. When cross sections of the membrane were to be obtained, parallel or perpendicular to the handle of the malleus, the external canal was removed and the lateral wall of the tympanic cavity was isolated *in toto* and embedded in gelatin. By this method sections obtained with a freezing microtome permit easier orientation and are, moreover, less fragile.

The observations were made in polarized light with a Zeiss polaroid attached to a microscope with a movable graduated stage. The most characteristic pictures were photographed; the others were drawn with the aid of the camera lucida.

7. Békésy, G.: Über die Messung der Schwingungsamplitude der Gehörknöchelchenkette mit einer kapazitiven Sonde, Akust. Ztschr. **6**:1-16, 1941.

OBSERVATIONS

Attention was given to the shape of the tympanic membrane, the character of the radial fibers and the structure of the parabolic fibers.

I. *Shape of the Tympanic Membrane.*—In all the examined species the shape of the tympanic membrane was that of a pseudocone, with an apical angle of 120 degrees, cut either parallel (guinea pig, fig. 1) or obliquely (dog, fig. 2; cat; ox, figs. 3 and 5*B*; sheep; pig; horse, fig. 4) to its base. Consequently, the apex of the cone, the umbo of the membrane, was seen more or less excentric in relation to the circumference of the membrane, and so was the handle of the malleus in relation to the ideal plane of section of the cone. Fumagalli [1] has shown (fig. 5*A*) that only in the guinea pig is the plane of the base of the membrane parallel to the axis of rotation of the ossicular chain. In the other species, this plane and the axis of rotation converge forward to form an acute angle. This angle is most acute in the rabbit (20 degrees) and widest in the ox (fig. 5*B*) and in the horse (39 degrees), while in the pig (5*C*), sheep and dog the angle is at an intermediate point (30 to 32 degrees). In this way a direct ratio exists between the degree of excentricity of the handle of the malleus and of that of the umbo on the one side and the obliquity of the axis of rotation of the ossicular chain on the other. This excentricity is responsible for the different lengths of the radial fibers in the posterior and the anterior quadrants of the drum membrane. Some authors attributed a peculiar acoustic significance to this fact. They compared the texture of the tympanic membrane to a group of piano strings with each element, of different length, tuned to a particular note. I shall discuss the improbability of this conception.

II. *The Radial Fibers.*—In all the examined species, the radial fibers originate from the handle of the malleus and, to be exact, from the area limited by the long and the short process and proceed to the crista tympani. Their disposition, however, is different according to the individual species and can be described as follows:

1. In the guinea pig the radial fibers run, isolated from the crista tympani, to the handle of the malleus, appear uniform along their whole course and are rather stiff and coarse (fig. 6*A*).

2. In the rabbit they are grouped into thin bundles, each independent of the other, from the peripheral attachment to the handle of the malleus. They show the same disposition as found by Fumagalli [1b] in man.

3. In all the other species, as against the above two, they are woven into a dense plexus. The lamina propria of the tympanic membrane becomes, thereby, a solidly built membrane, and within its structure the radial fibers lose their identity.

In all the species with a solid layer formed by the radial fibers, the lamina propria is traversed by regularly shaped and placed clefts (fig. 6*B*), starting from the periphery of the drum membrane as well as from the handle of the malleus. The clefts are triangular, with their bases attached, respectively, to the periphery of the membrane or the manubrium. The point of the peripheral ones alternate with the points of the central ones. Their width is in relation to the area in which they are located. At the periphery of the membrane, outside of the inextricable

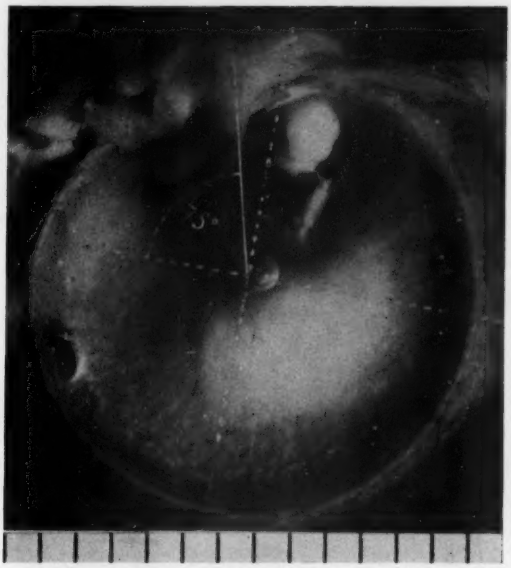

Fig. 1 (guinea pig).—Drum membrane and ossicles seen from their medial aspect. The horizontal dotted line indicates the projection of the main horizontal plane; the vertical dotted line, the projection of the frontal plane. The longitudinal axis of the handle of the malleus forms, with the horizontal plane, an angle of 75 degrees. The stapedial basis, seen from the vestibulum at the same enlargement, has been inserted in such a way that its surface can be compared with the surface of the drum membrane.

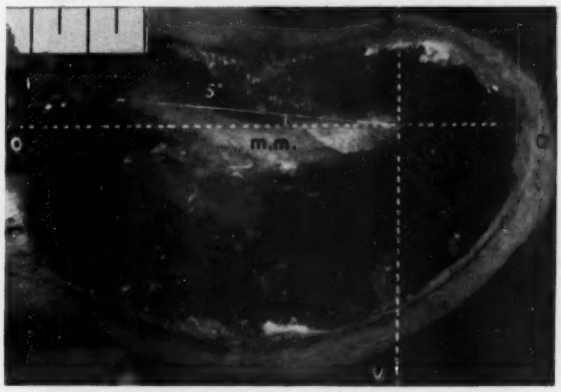

Fig. 2 (dog).—On the tympanic membrane, in this and in the two succeeding figures, the horizontal (*O* to *O*) and frontal (*V* to *V*) planes were drawn. The longitudinal axis of the handle of the malleus forms, with the horizontal plane, an angle of 5 degrees; *m-m.* indicates the handle of the malleus.

Fig. 3.—Ox.

Fig. 4.—Horse.

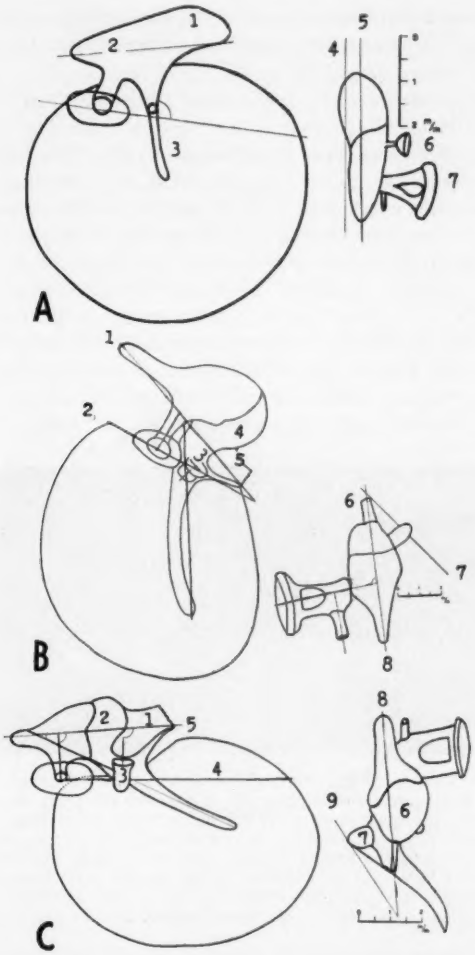

Fig. 5.—*A* (guinea pig), lateral projection of the sound-transmitting apparatus. In this figure, *1* indicates the head of the malleus; *2*, the body of the incus; *3*, the handle of the malleus; *4*, the plane laid through the basis of the tympanic membrane; *5*, the axis of rotation; *6*, the tensor tympani, and *7*, the stapes. *B* (ox), lateral projection of the sound-transmitting apparatus and projection of the sound-transmitting apparatus from above. The plane of the basis of the tympanic membrane is parallel to the plane of the page. The plane of the basis of the stapes is perpendicular to the plane of the page; *1* indicates the axis of rotation; *2*, the horizontal plane of the head; *3*, the tensor tympani; *4*, the head of the malleus; *5*, the processus anterior mallei; *6*, the processus brevis mallei; *7*, the plane passing through the basis of the tympanic membrane, and *8*, the axis of rotation. *C* (pig), lateral projection of the sound-transmitting apparatus and projection of the sound-transmitting apparatus from above. In this figure *1* indicates the processus anterior mallei; *2*, the head of malleus; *3*, the tensor tympani; *4*, the horizontal plane of the head of the malleus; *5*, the axis of rotation; *6*, the tensor tympani; *7*, the processus brevis mallei; *8*, the axis of rotation, and *9*, the tympanic membrane.

plexus formed by the radial fibers, isolated, short bundles originate like those found in man (Fumagalli [1b]) and in the guinea pig. They connect the lamina propria with the fibrous ring.

III. *Structure of the Parabolic Fibers.*—A. Tympanic Membrane of the Rat, Guinea Pig and Rabbit: The respective membranes of these three can be described together since no differences were found between them. On the medial surface of the cone, as formed by the radial fibers, two bundles are observed. They appear at their origin, near the short process of the malleus, ribbon shaped, and proceed toward the anterior and the posterior superior quadrants respectively. They are analogous with the parabolic clusters in man and thus might be called "the anterior and the posterior parabolic bundle." They are identical in size. After a short course they resolve themselves, fanlike, into the constituting fibers, the posterior fan being wider than the anterior. Some fibers reach the fibrous ring in a straight line, entering the ring united to the radial fibers. Others, more numerous, follow a circular course, running parallel to and at different distances from the fibrous ring and finally entering it once they reach the periphery opposite their starting

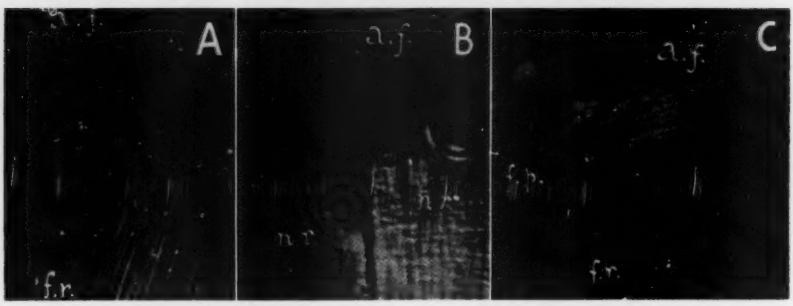

Fig. 6.—*A* (guinea pig), the lamina propria of the tympanic membrane is formed by thick collagenous fibers, which are isolated along all of their course from the crista tympani to the handle of the malleus (polarized light); *a.f.* indicates the crista tympani, *f.r.*, the radial fibers. *B* (cat), peripheric portion of the lamina propria of the drum membrane, in which the radial fibers unite into anastomotic clusters, forming a large and solid structure with radial clefts (polarized light). In this figure *a.f.* indicates the crista tympani; *n.r.*, the radial stripes. *C* (guinea pig), superior-posterior quadrant of the drum membrane (polarized light). In this figure *f.p.* indicates the posterior parabolic bundle; *f.r.*, the radial fibers, and *a.f.*, the crista tympani.

point. In this way the fibers of the anterior parabolic bundle attach themselves posteriorly, and vice versa. In their course, the fibers, always well isolated, become intertwined to form a mesh with lozenge-shaped spaces, the peripheral ones being narrower. Owing to this arrangement, those near the periphery appear so close as to resemble a small bundle. The mesh formed by the fibers of the parabolic clusters covers the two peripheral thirds of the tympanic membrane (fig. 6*C*). No crescentic bundle, as it appears in man, could be discovered in the tympanic membrane of these three species.

B. Tympanic Membrane of the Horse: On the medial surface of the cone formed by the radial fibers, two different types of bundles are seen. One resembles perfectly the crescentic bundle in man, the other the parabolic bundles.

The crescentic bundle is situated at the periphery of the membrane; sometimes it runs a few millimeters from the fibrous ring. Its oblique branches reach the tympanic spinae. The concave inner border is turned against the umbo and is rather thin, while the convex external border is turned against the fibrous ring and much thicker.

The fibers forming the crescentic bundle belong to two different types. Some fibers follow a parallel and circular course to the fibrous ring; they belong to the parabolic bundles and will be discussed later. Others, on the contrary, are placed in such a way as to build a number of small arches fixed to the fibrous ring and to connect the two groups with their convexity against the umbo. Through the arches, as through buttonholes, pass the circular fibers coming from the parabolic bundles (fig. 7).

Two bundles originate from the short process of the malleus, rich in fibers packed densely near their origin. One runs toward the anterior quadrants, the

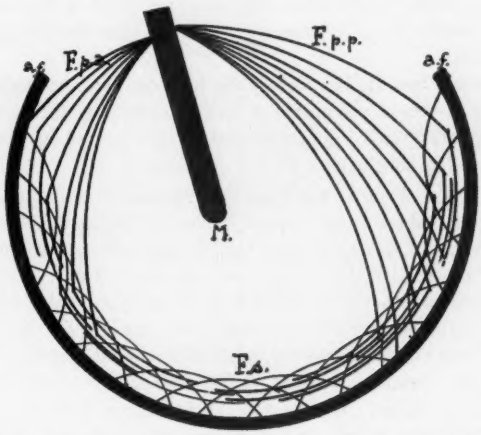

Fig. 7.—Diagram of the crescentic-parabolic system. In this figure *a.f.* indicates the fibrous ring; *M.*, handle of the malleus; *F.p.a.*, the anterior parabolic bundle; *F.p.p.*, the posterior parabolic bundle, and *F.s.*, the crescentic bundle.

other against the posterior ones. They are the anterior and posterior parabolic bundles, the anterior being the thinner one. They unravel soon into fans of fibers running in the direction of the periphery of the drum membrane and reach the crescentic bundle, in which they end (fig. 5 *A*).

C. Tympanic Membrane of the Sheep, Ox and Pig: The membranes of these animals can be described together for there is no difference in the disposition of their parabolic fibers. In these animals, as in the rodents, one sees only the parabolic bundles. Here, too, there are two such bundles, an anterior and a posterior. They rest on the medial surface of the flattened cone formed by the radial bundles.

Both parabolic bundles, but especially the posterior one, are rather thick, much more so than in man or in the horse. Near their origin, from the short process of the malleus, they unravel into broad fans, whose single bundles, once they reach the periphery of the membrane, enter the fibrous ring in the shape of radial ribbons.

By running first along the medial surface of this ribbon and then merging into it, the bundles form a loop, with the concavity against the anterior quadrants when the fibers originate from the anterior parabolic bundle, and vice versa. Finally, running along the lateral surface of the ribbon, the bundles reach the fibrous ring (fig. 5 *B*).

D. Tympanic Membrane of the Dog and the Cat: The parabolic bundles of these two animals show the same character as those in the Ungulata. The Carnivora, too, lack a crescentic bundle. The description given above will sufficiently explain the condition in these animals.

COMMENT

In two previous studies (Secondi [8]), I tried to give a systematic description of the disposition of the collagenous fibers forming the lamina propria of the tympanic membrane in various animals. In the first article I was concerned with the morphology, postponing for the time being the discussion of the functional implications. I waited until a broader basis was given by other investigations carried out in our department.

In the meantime, two studies were published, one by Fumagalli,[1b] the other by Filogamo.[3] The results of my previous investigations, together with the results of studies by Fumagalli [1b] and Filogamo [3] and those reported in this paper, are the basis of the following conclusions.

1. Concerning the shape of the tympanic membrane and the difference in the length of the radial fibers, Fick [9] and Cipollone [10] maintained that the tympanic membrane is capable of tuning to an infinite sound scale, since each fiber or group of fibers would be consonant to a particular acoustic stimulus. Fumagalli criticized this structural interpretation of the conditions in the typmpanic membrane. On the basis of the hypothesis of Fick and Cipollone, one could not explain why the tympanic membrane of the guinea pig, with all its radial fibers of the same length, is able to transmit vibrations between 16,000 and 35,000 double vibrations, almost doubling the human range. In accord with Fumagalli, I think that the different length of the radial fibers depends not on acoustic needs but on topographic and mechanical conditions.

2. Concerning the structure of the lamina propria in the different species which were studied, it was demonstrated that it is formed by two types of fibers, which should be called radial and parabolic fibers.

(*a*) The radial fibers appear isolated (guinea pig), collected into bundles (radial ribbons of the rabbit) or collected into large ribbons with a matted structure (horse, ox, sheep, pig, dog, cat). In the last-mentioned form, the lamina is permeated by clefts, starting from the periphery as well as from the handle of the malleus and placed in such a way that the free ends of the two groups are intertwined. From

8. Secondi, U.: (*a*) Ricerche anatomiche sul sistema di fibre parabolico-semilunari della lamina propria della membrana del timpano di alcuni mammiferi domestici, Rendic. Inst. Lombard Sc. e Lett. **77**:548-556, 1943-1944; (*b*) Architettura della fibre collagene della lamina propria della membrana del timpano di alcuni mammiferi, Atti Soc. ital. Laring. **25**:700-717, 1946.

9. Fick, cited by Cipollone.

10. Cipollone, F.: Ricerche anatomiche sul labirinto membranoso e sull' organo dell' udito, Milano, 1926.

a mechanical viewpoint, this disposition has a double advantage: The fibers of the small bundles being independent of each other, the texture of the membrane can undergo strong deformations without appearance of folds or wrinkles at the points of uneven displacement, as is the case with small membranes of a relatively narrow surface (guinea pig, rabbit). In the case of a wider tympanic surface, where a greater stiffness of the lamina propria is needed, the structure with isolated bundles is not sufficient. In all these species (dog, cat, pig, ox, horse), the bundles build a matted plexus permeated by clefts, with the clefts placed in such a manner that the cone of the membrane can be deformed with relative ease. Even when this plexus is flattened or pressed inward, no wrinkles are formed on its surface (fig. 5). In spite of the stiffness of the texture of the structure in these species, the mechanical properties do not differ from those of the smaller membranes with isolated fibers.

Fig. 8.—Diagram. Rings of the circular fibers (fixed to the handle of the malleus), with changing position of the handle. Since they are independent from each other, they are displaced in such a way that the radial fibers may be either straightened or bent without their tension being changed.

(*b*) The parabolic fibers form a complex system resting on the inner surface of the cone built by the radial fibers. A first group of fibers form the parabolic bundles which originate from the short process of the malleus and, running forward and backward respectively, reach the inferior quadrants of the membrane. I described two types of parabolic bundles: the parabolic reticular bundles of the rodents, unraveling at their point of origin (short process of the malleus) into a mesh covering the two peripheral thirds of the membrane and reaching the tympanic crista, and the parabolic loop of bundles in the Ungulata and in the Carnivora, which merge at their inferior end into the tympanic crista.

A similar disposition was found in man by Leonardelli in investigations aimed to determine exactly the ending of the fibers of the parabolic bundles. This question was not thoroughly solved by the previous studies of Filogamo and Fumagalli.

It may be concluded on the basis of the work done in our department that in domestic animals as well as in man all the parabolic bundles end at the periphery of the membrane and precisely at the point of the circumference opposite their origin (posteriorly, in the case of the anterior bundles, and vice versa).

A second group of fibers (parabolic fibers of the third order, according to Filogamo) runs from the anterior or posterior edge of the handle of the malleus to the upper margin of the membrane and to the anterior and posterior malleolar ligaments, after turning around the umbo. A third order of parabolic fibers is formed by the crescentic bundle, appearing in this form only in the horse. These fibers run a parabolic course from one point of the fibrous ring to another, forming a number of small arches with their convexity against the umbo, through which pass, as through buttonholes, the fibers of the parabolic bundles. The three systems of fibers act as a whole, according to the following tentative function: It was demonstrated (fig. 8) that the parabolic fibers form loops which cannot be stretched,

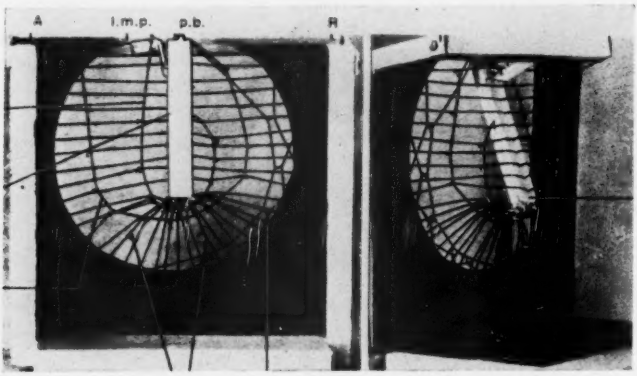

Fig. 9.—Model of the tympanic membrane. The figure on the left is seen laterally, that on the right, in profile. *A* to *R* indicates the axis of revolution of the ossicular chain; *p.b.*, the short process of the malleus, and *l.m.p.*, the posterior ligament of the malleus.

fixed with one end to the malleus and with the other to the periphery of the membrane and to the malleolar ligaments; in this way they follow the position assumed by the long process of the malleus and are displaced as a whole toward the base or toward the apex of the cone. From this arrangement it results that the entire membranous surface can be stretched uniformly by the three systems of fibers. With displacement of the malleus laterally, against the external canal, the radial bundles relax building loops, since the handle, in front of the outline of the membrane, approaches the extreme fixation points of these bundles (fig. 9).

On the other hand, the parabolic bundles will stretch, since the short process is elevated, moving away from the inferior periphery of the membrane; the true circular fibers, fixed to the long process and to the malleolar ligaments, maintain constantly the same distance between their fixation points during the displacements of the malleus. As a matter of fact, both are elevated or lowered, according to the displacements of the malleus, toward the external auditory canal or toward the cavity. The fibers forming the parabolic systems act as a noose around the lower

portions of the membrane in the area between the fibrous ring and the umbo; it stretches the radial fibers upward, bending them with relaxation and straightening them with stretching. In my previous paper on the subject,[8a] I called the parabolic crescentic system the "balance apparatus of the tympanic membrane," renouncing any functional interpretation of the parabolic fibers. Observations made so far show that in this term one must include all the parabolic fibers of the tympanic membrane, since all of them perform, each according to a particular pattern, the same function, which is to maintain a balance of tension between different points of the lamina propria.

Filogamo, in the course of his investigations into the structure of the tympanum of mammals, presents essentially the same outlines as those suggested by me in 1944 and 1946 and later by Leonardelli and Fumagalli.[1b]

From the study of the tympanic membrane in mammals, the conclusion can be drawn that this membrane presents a surface which, on the basis of its structure, changes its shape easily (from a cone with rectilinear generatrices to a pseudocone with bent generatrices) while maintaining, to a certain degree, its stiffness. Because of this fact and because of its peculiar fixation to the tympanic ring, the tympanic membrane can vibrate as a whole, as was shown by Békésy, like the dynamic cone of a loud speaker. Because of its ability of deformation, it can appear hollowed or flattened, while the degree of tension of the collagenous fibers forming its lamina propria does not change.

I have already discussed [8b] the importance of this fact from the standpoint of acoustics. Finally, the handle of the malleus, though interwoven solidly and intimately into the cone of the membrane, is able to change its position without producing a difference in the tension of the fibers.

One can conclude that the handle of the malleus and the tympanic membrane, in spite of the appearance, maintain a relative independence with a resulting constancy of the mechanical properties of the membrane, whatever may be the position of the handle of the malleus.

SUMMARY

By dissection and in polarized light, the shape and character of the radial fibers and structure of the parabolic fibers of the tympanic membranes were studied in various animals.

The disposition of the radial and the parabolic fibers plays an important role in relation to the mechanical properties of the tympanic membrane. This membrane, on the basis of its structure, can change its shape as well as its degree of tension, but this ability does not modify the tension of the collagenous fibers of the membrane. Since the tension of the fibers is constant, the mechanical properties of the membrane remain always unchanged.

PSYCHOPHYSIOLOGY OF SPEECH HEARING

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AND
MATTHEW S. ERSNER, M.D.
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THE FORMATION of meaningful patterns from vibrations falling on the ear depends on two anatomic components: the peripheral organ of hearing and the cortical association and memory centers. Ordinarily, the cerebrum is capable of filling in gaps in the picture presented by the peripheral organ. The brain is able to complete a word picture when only a part of the word is heard, and a sentence is constructed by the cerebral cortex from a few words and auditory cues. In Arnold's experiment [1] the listener has no trouble in understanding every word when speech is transmitted through a filter system delivering frequency components below 1000 cycles to the right ear, while all components with frequencies above 1000 double vibrations are being sent into another channel and delivered to the left ear at the same time. Thus, the brain is capable of creating meaningful patterns from fragmentary sound sensations gathered from the two ears. The peripheral organ is generally credited with tone discrimination and loudness perception in response to vibratory stimuli with the physical attributes of frequency and intensity. The recent studies of Dix, Hallpike and Hood [2] indicate that under certain conditions, as in Ménière's disease, the cochlea possesses the recruitment factor, which brings about a greater gain in loudness with a correspondingly smaller increase in intensity. Previously, Fowler [3] described this phenomenon as being distinctive of nerve deafness.

Clinically, it has been shown by de Crinis,[4] by Falkenberg [5] and by us [6] that in the presence of a lesion of the central nervous system speech hearing is poorer than the pure tone acuity. In cochlear damage, because of toxins or acoustic trauma, a discriminatory defect is the outstanding difficulty. Frequently, the defect persists in spite of the best possible amplification. This condition is also encountered in presbycusis and in idiopathic high tone deafness. In Ménière's disease with decided low tone impairment, speech hearing intelligibility is affected to a greater degree than the discrete frequency acuity. Our studies yielded results comparable with

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1. Arnold, cited by Fletcher, H.: Speech and Hearing, New York, D. Van Nostrand Co., Inc., 1929, p. 196.

2. Dix, M. R.; Hallpike, C. S., and Hood, J. D.: Proc. Roy. Soc. Med. **41**:516, 1948.

3. Fowler, E. P.: Laryngoscope **48**:572, 1938.

4. de Crinis, M.: Arch. f. Ohren-, Nasen-u. Kehlkopfh. **148**:183, 1941.

5. Falkenberg, K.: Arch. f. Ohren-, Nasen-u. Kehlkopfh. **149**:187, 1941.

6. Saltzman, M., and Ersner, M. S.: Eye, Ear, Nose and Throat Monthly **28**:523, 1949.

those of Dix, Hallpike and Hood,[7] who state, "While recruitment of loudness is the rule, recruitment of intelligibility, which might be expected, may be conspicuously absent. In fact, the opposite would appear to occur, namely, that as loudness increases, intelligibility falls off." In otosclerosis, the hearing loss for speech is greater than for pure tones. We [8] found that the impairment is more pronounced for words with low frequency components than for those falling within the high frequency range. With adequate amplification, however, the otosclerotic patient achives a greater degree of speech intelligibility than is ever attained by a "nerve" deafened person.

These clinical observations suggest the existence of some psychophysiological factors in speech hearing that have not been clearly defined yet. To begin with a basic consideration, namely, the comparison between speech intelligibility and pure tone acuity, some workers [9] found an interdependence between these two forms of auditory perception. According to these authors, the hearing loss for speech could be predicated from the average impairment for frequencies 512 to 2048.

Carhart [10] encountered the presence of linearity in both conduction and perception deafness and ascribed discrepancies to psychological conditions. Responses to speech stimuli may be better or worse than responses to discrete frequencies in psychogenic deafness, inferior intelligence, lack of cooperation and malingering. A neurological disturbance may interfere with the integration of auditory patterns into language symbols, and, accordingly, the hearing acuity for pure tones would be better than the threshold for speech reception.

In unilateral deafness a greater loss for speech intelligibility cannot be due to a cerebral component if the other ear shows no similar condition. In impairment of the peripheral organ, amplification usually gives an adequate increase in speech intelligibility. It is conceivable, however, that in deafness of peripheral origin a factor might be present that would annul the intelligibility of speech even when made loud by electric amplification. A factor may be present that reduces the efficacy of slight or moderate amplification but permits perfect intelligibility of loud speech. Still another factor may interfere with speech hearing at a distance in spite of amplification and in the absence of a defect at a higher neurological level. These factors were isolated by us and will be presented here with case reports.

To attain laboratory precision in speech hearing, we used the Hudgins [11] spondee records on the PR2[9] turntable attached to the Maico audiometer. This test material has the most homogeneous intelligibility available, but as pointed out by Harris,[12]

7. Dix, M. R.; Hallpike, C. S., and Hood, J. D.: Proc. Roy. Soc. Med. **42**:527-536, 1949.

8. Ersner, M. S., and Saltzman, M.: Speech Hearing in Otosclerosis, Arch. Otolaryng. **46**:753 (Dec.) 1947.

9. Fletcher, H.: Speech and Hearing, New York, D. Van Nostrand Co., Inc., 1929. Hughson, W., and Thompson, E.: Correlation of Hearing Acuity for Speech with Discrete Frequency Audiograms: Method of Determination, Arch. Otolaryng. **36**:526 (Oct.) 1942. Harris, J. D.: Free Voice and Pure Tone Audiometer for Routine Testing of Auditory Acuity: Studies on Comparative Efficiency, ibid. **44**:452 (Oct.) 1946.

10 Carhart, H.: Ann. Otol., Rhin. & Laryng. **55**:233, 1946.

11. Hudgins, C. V.; Hawkins, J. E.; Karlin, J. E., and Stevens, S. S.: Laryngoscope **57**:57, 1947.

12. Harris, J. D.: Some Suggestions for Speech Reception Testing, Arch. Otolaryng. **50**:388 (Oct.) 1949.

these records have a frequency limitation. The spondee lists sample hearing of relatively low tones. Our study was facilitated by the narrowing of the test to the lower speech registers.

REPORT OF CLINICAL CASES

CASE 1.—On March 15, 1949, B. F. R., a white man aged 73, consulted us for the complaint of difficulty in hearing conversation at a distance of 5 feet (152 cm.) or more. The patient never experienced any vertigo. Mild tinnitus of the nature of "escaping steam" was present bilaterally. The hearing difficulty dated back three years and was becoming progressively worse. The patient enjoyed good health. Otoscopy and nasopharyngoscopy disclosed no abnormalities. The orifices of the eustachian tube were patent. There were no abnormal spontaneous neuro-otological findings, and the Bárány caloric test performed on both ears elicited normal responses.

Audiometry showed a high tone loss bilaterally and a slight impairment for the low frequencies in the right ear. A moderate degree of recruitment for pure tones was present. The threshold level of intelligibility for spondee words was a 15 decibel loss for the left ear and a 20 decibel loss for the right. The patient was fitted with the best available transmitter-receiver

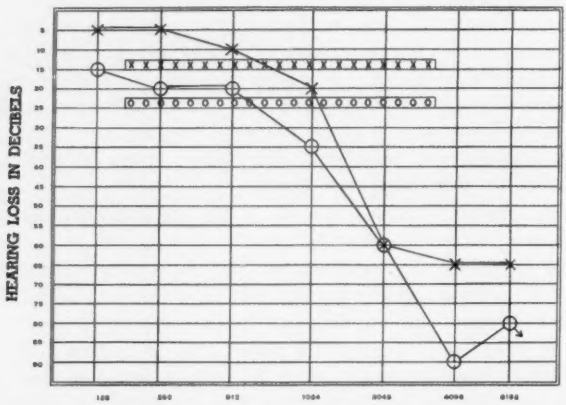

Chart 1 (case 1).—Presbycusis and high tone deafness. In this figure and in the others the circles indicate the right ear; the crosses indicate the left. The bar with the crosses indicates the threshold of intelligibility for spondee words in the left ear, the bar with the circles, that in the right.

hearing aid combination for high frequency emphasis and low tone suppression. He reported "little improvement in understandable conversation from most people at a distance; footsteps, rustling of paper and tapping noises are brought out plainer."

Comment.—The audiological diagnosis was high tone deafness. Some persons with the type of audiogram that this patient presented have more difficulty in hearing conversation at a distance than others. It was pointed out by one of us (M. S.) [13] "that the normal ear is more sensitive to some consonants largely as a function of frequency in respect to the distance at which such sounds are heard." Kerrison [14] states that *s* and *sh* sounds carry farthest and can be heard three times as far as *f, v, t, th, d* and *k*. Again, *f, v, d,* and *k* are heard farther than *b* and *p*. This special sensitivity is frequently lost in presbycusis associated with high tone deafness. The

13. Saltzman, M.: Clinical Audiology, New York, Grune & Stratton, Inc., 1949.

14. Kerrison, P. D.: Diseases of the Ear, ed. 3, Philadelphia, J. P. Lippincott Company, 1923, p. 82.

high consonants are normally weak in sound power, and their audibility at a distance is nature's special gift to the normal ear. All the hearing aid can do is to augment sound power. The presbycusic ear can be benefited by augmented power only if the special sensitivity of the ear for hearing the weak high consonants at a distance is not entirely lost. This patient had no marked loss for spondee words as they sample hearing of relatively low tones.

CASE 2.—On June 10, 1950 S. H., a white man aged 56, consulted us for the complaints of deafness, tinnitus and vertigo. The patient recalls having had mild vertiginous attacks in the past few years. One moderately severe attack of vertigo occurred in April 1949. In the right ear, impairment of hearing associated with tinnitus dated back to 1947. Since the attack of vertigo in 1949, the patient had become conscious of a hearing defect and double-pitched tinnitus in the left ear. The most of his difficulty in hearing was experienced in group conversation and in noisy surroundings. Physical examination, including that of the ears, nose, nasopharynx and throat, disclosed no significant abnormalities. There were no abnormal spontaneous neuro-otological findings. The Bárány caloric tests elicited normal responses from each ear after prolonged massive douching.

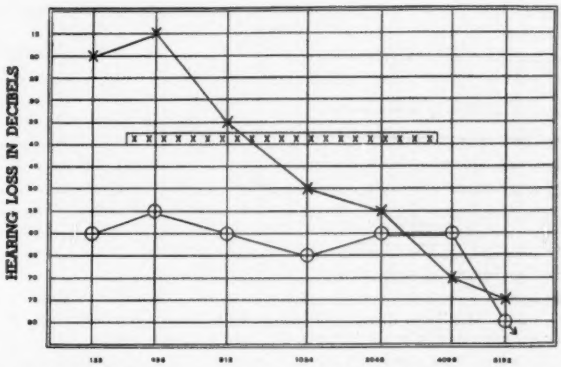

Chart 2 (case 2).—Ménière's disease. The bar with the crosses indicates the threshold of intelligibility for spondee words in the left ear. There was no intelligibility for speech at any degree of amplification in the right ear.

Chart 2 is the audiogram of this patient. For pure tones by air conduction, the right ear had a decided loss for all frequencies, while the left ear showed a sloping, high tone impairment. Bone conduction was extremely poor in both ears. The recruitment phenomenon was present for frequencies 1024 to 4096. In the right ear, intelligible speech hearing was impossible, even with the highest amplification obtainable on the microphone circuit of the Maico audiometer. In the left ear, speech hearing was satisfactory at an amplification of 50 to 55 decibels, and the 50 per cent threshold for spondee words was at the 40 decibel level.

Comment.—In this case, the diagnosis was Ménière's syndrome bilaterally. The right ear, which had a profound impairment for the low frequencies, showed a loss of speech intelligibility which was out of proportion to the pure tone involvement. Amplification made discrete sounds loud enough but had no effect on the understandability of the spoken word. This phenomenon cannot be attributable to a fault in the central nervous system, for the left ear was not similarly affected. However, frequency discrimination and appreciation of loudness were present in the right ear. Then, the question arises, why cannot the brain integrate these sounds into mean-

ingful patterns? The answer is that in the scheme of speech hearing the cochlea contributes an additional factor. It may be designated "the transmission fidelity factor." Normally, it is the function of the cochlea to transmit speech sounds with adequate characteristics to enable the brain to formulate meaningful patterns. Ménière's disease, frequently being featured by gross diplacusis, shows a loss in speech intelligibility in proportion to the deficiency in the transmission fidelity factor.

This case proves also that an ear with Ménière's disease is not necessarily devoid of recruitment in speech intelligibility. Amplification was quite effective in improving speech hearing in the left ear. It appears that in Ménière's disease a pronounced loss for the low frequencies renders the ear prone to a deficiency in the transmission fidelity factor.

Case 3.—J. W. D., a white man, aged 41, consulted us on April 7, 1950. His complaints were episodic vertigo, deafness and bilateral tinnitus. The first attack of vertigo occurred in 1948. About the same time, tinnitus in the right ear became troublesome and the patient became cognizant of an impairment of hearing in that ear. Following a vertiginous attack in March 1949, double-pitched tinnitus appeared in the left ear. At present, the head noises in the left ear are more constant and more annoying than the tinnitus in the right ear. The referring physician

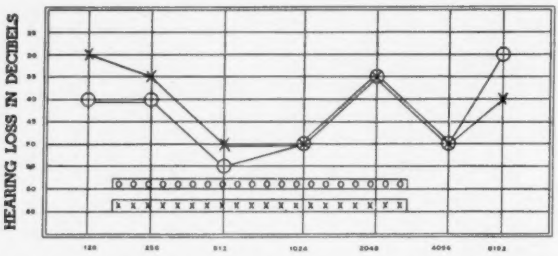

Chart 3 (case 3).—Ménière's disease. The bar with the crosses indicates the threshold of intelligibility for spondee words in the left ear, the bars with the circles, that in the right.

reported the patient to be in good general health. The examination of the ears, nose, throat and nasopharynx disclosed no gross abnormalities. The reaction to the Romberg test was negative. There were no spontaneous nystagmus and no past pointing. The Bárány caloric test elicited normal but hypoactive responses from both ears. Hearing tests proved that the patient had a handicapping degree of deafness. The audiogram was zigzag, and bone conduction was extremely poor bilaterally. Diplacusis was present, the sounds being higher pitched in the left ear. Recruitment for discrete frequencies was present. The threshold level of speech hearing for spondee words was a 55 decibel loss for the right ear and a 60 decibel loss for the left.

Comment.—This patient with Ménière's disease showed a greater loss for speech hearing than for pure tone acuity. In spite of a better audiogram, the left ear was poorer for word intelligibility than the right. This poorness may be accounted for by the severer tinnitus and the higher pitch of the diplacusis in that ear. However, adequate sound power did bring about some recruitment of speech intelligibility. This observation is in line with our experience in most cases of Ménière's disease that amplification does improve speech hearing. The relationship between the understandability of conversation and pure tone acuity is definitely not linear. There is a deficiency in the transmission fidelity factor that cannot be made up by an increase in sound power. Consequently, in Ménière's disease, only a moderate improvement in speech hearing can be brought about by amplification.

CASE 4.—M. E. A., a white woman aged 51, consulted us on June 13, 1949. Impairment of hearing was noted during high school days, and it had been getting progressively worse. The patient did not recall ever having had an attack of vertigo, but tinnitus, which had been present bilaterally, was annoying in the right ear intermittently. Otoscopy showed moderate retraction of both drum membranes. Nasopharyngoscopy revealed no abnormality. The audiogram was typical of conduction deafness. The reaction to the Rinne test was negative bilaterally. No recruitment was present in either ear. The threshold for the spondee lists was higher than for pure tones. Adequate amplification gave perfect speech hearing. There were no abnormal spontaneous neuro-otological findings, and the Bárány caloric test elicited normal responses.

Comment.—The diagnosis in this case was otosclerosis. In the uncomplicated case, most perfect speech hearing is obtained through a well fitted hearing aid. Yet, without amplification, the understandability of the spoken word lags behind pure tone hearing. It could not be said that a deficiency in the transmission fidelity factor exists in this disease, for how could it be restored by increased sound power? However, it is logical to assume that the fine shades of speech characteristics require adequate sound power to be transmitted with full fidelity.

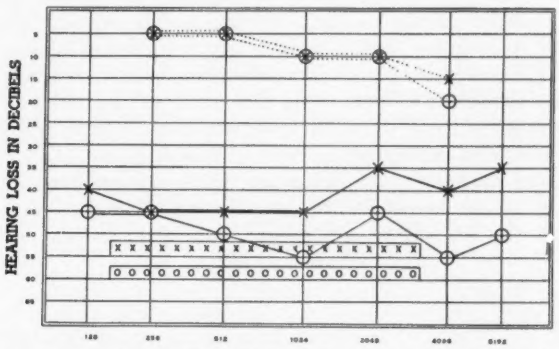

Chart 4 (case 4).—Otosclerosis. The solid line indicates air conduction, the dotted line, bone conduction. The bar with the crosses indicates the threshold of intelligibility for spondee words in the left ear, the bar with the circles, that in the right.

The otosclerotic ear falls short in gaining in loudness with the moderate increase in intensity of a sound in contradistinction to the normal ear, which gains proportionately in loudness with augmented intensity. By the recruitment phenomenon, the nerve-deafened person obtains a greater increase in loudness with a correspondingly smaller increment of intensity.

One of us (M. S.) [18] ascribed the lagging speech hearing in otosclerosis to an irregularity in the relationship between the loudness function and intensity. Loudness depends on the effective spread of vibration along the basilar membrane, its segments contributing to this attribute of sound in proportion to the strength of excitation.

In otosclerosis, the stimulation of a given segment takes place at its threshold, but when the intensity is increased just moderately, the physiological spread of vibration to the other segments does not take place as normally expected and, consequently, the proportionate degree of loudness is not produced. However, if speech sounds are amplified to a high degree of intensity, a more extensive vibration of the basilar membrane takes place and more of its segments contribute their proportionate

share of the loudness function, with the result that speech hearing acquires all the characteristics of normalcy. This phenomenon may be viewed as a loudness function peculiarity which causes a relative deficiency in the transmission fidelity factor.

SUMMARY

Speech sounds are integrated into meaningful patterns in the brain, which is capable of combining fragmentary sensations from the two ears. The filling in of gaps to complete a word picture is also a function of the cerebral cortex. Loudness perception and frequency discrimination are functions of the cochlea. Evidence exists that the process of recruitment of loudness takes place in the inner ear. An important factor in speech hearing is the fidelity with which the transmission of the characteristics of speech sounds is accomplished. The peripheral organ may be deficient in the transmission fidelity factor. In these circumstances the amplification of speech sounds will be of little or no aid toward intelligibility. We found that the ear with Ménière's disease and with a marked low frequency loss was most prone to this phenomenon. The deficiency in the transmission fidelity factor may be partial or total. In otosclerosis, the loudness function has an irregular relationship to intensity. The transmission fidelity factor is largely influenced by sound power in this disease. The normal ear possesses the unique capability of hearing certain weak consonants at a farther distance than other consonants with much more sound power. This advantage is lost partly or wholly in degeneration of the inner ear. It is most commonly encountered in presbycusis with high tone deafness.

These special functions of the cochlea are factors in speech intelligibility. Their deficiency may not be compensated by amplification. These considerations are of value in explaining why certain patients are benefited by hearing aids and others are not.

1923 Spruce Street.

1915 Spruce Street.

UNILATERAL PANSINAL MUCOCELE SIMULATING A MALIGNANT NEOPLASM

Report of a Case

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AND
HENRY L. WILLIAMS, M.D.
ROCHESTER, MINN.

MUCOCELES of the paranasal sinuses and their suppurating counterparts, pyoceles, are defined and discussed in standard textbooks on otolaryngology, and the reports of cases in the literature now number in the hundreds. Mucoceles originating in the sphenoid sinus are rare, and a true mucocele of the maxillary sinus is uncommon. For this reason our case in which a true mucocele was found in the antrum associated with a mucocele on the same side, arising in the sphenoid sinus with extensive erosion of the ethmoid roof and destruction of the sella turcica, seems of sufficient interest to be recorded.

REVIEW OF THE LITERATURE

Wilkerson [1] credited Nicolai,[2] of Strasbourg, France, with the first published report of a case of mucocele in 1725. Linthicum and co-workers [3] stated that Garreau [4] first called attention to this condition in 1881 and that Rollet [5] introduced the term mucocele in 1896. Turner [6] reported 10 cases in 1907, and by 1909 Gerber [7] was able to collect 178 cases.

The etiology of this condition has been the subject of much conjecture. Daily [8] emphasized previous trauma as a cause, and Cavanaugh [9] suggested vitamin and endocrinal deficiency. Howarth [10] felt that anatomic configuration of the ethmoid

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From the Section on Otolaryngology and Rhinology (Dr. Williams), Mayo Clinic.

1. Wilkerson, W. W., Jr.: Mucocele of the Frontal Sinus: Report of a Case, Arch. Otolaryng. **34**:321-339 (Aug.) 1941.

2. Nicolai, cited by Wilkerson.[1]

3. Linthicum, F. H.; Rand, C. W., and Reeves, D. L.: Mucocele of the Sphenoid Sinus: Report of a Case with Autopsy Findings, J. Neurosurg. **3**:444-453 (Sept.) 1946.

4. Garreau, cited by Linthicum, Rand and Reeves.[3]

5. Rollet, cited by Linthicum, Rand and Reeves.[3]

6. Turner, A. L.: Mucocele of the Accessory Nasal Sinuses, Edinburgh M. J. **22**:396-410; 481-501, 1907.

7. Gerber, cited by Linthicum, Rand and Reeves.[3]

8. Daily, L.: Mucocele of the Frontal Sinus, Ann. Otol., Rhin. & Laryng. **35**:834-837 (Sept.) 1926.

9. Cavanaugh, J. A.: Mucoceles of the Frontal Sinus, Laryngoscope **45**:205-214 (March) 1935.

10. Howarth, W. G.: Mucocele and Pyocele of the Nasal Accessory Sinuses, Lancet **2**: 744-746 (Oct.) 1921.

sinuses was important, particularly when some of the anterior cells of the ethmoid sinuses are found in front of the nasofrontal duct and bulge into the floor of the frontal sinus. In such circumstances, a blow to the frontal region or an inflammation can obstruct the duct and lead to formation of mucocele. Williams and Mousel [11] stated that closure of the nasofrontal opening resulting in slow accumulation of mucoid secretion, which gradually displaces and absorbs bony walls of the sinuses, may produce a mucocele or, if infected, a pyocele. Lillie and one of us (H. L. W.) [12] pointed out the possibility of postoperative development of a mucocele in the mucous membrane left in the lateral angle of the frontal sinus if this region became blocked off. Weille [13] reviewed 276 external frontal operations and reported that 16 postoperative mucoceles and pyoceles followed the Jansen-Lynch or the Killian operation and only three followed obliteration of the frontal sinus.

Mucoceles, as mentioned before, are not uncommon and usually arise in the ethmoid and frontal sinuses, but Morman [14] stated, "Mucoceles of the maxillary and sphenoid sinuses have been reported but are uncommon." Turner and associates [15] stated in 1936, "It is doubtful if a parallel condition [mucocele] has been found in the antrum." Chamberlin and Parry [16] commented in 1933 that the sphenoid sinus had rarely been the site of origin of mucoceles and that only two such cases had been reported. Linthicum, Rand and Reeves concluded in 1946 that not more than 25 cases of mucoceles of the sphenoid sinus had been reported. These authors stated further that mucoceles of the antrum of Highmore so far described in the literature contained only thin serous fluid and not the thick gelatinous and tenacious fluid characteristic of mucoceles of the frontal and ethmoid sinuses. They reported on a large mucocele of the sphenoid sinus. The patient underwent two craniotomies prior to needle aspiration of the cystlike mass via the intranasal route.

Hermann and Hall [17] reported a case comparable to, but not as extensive as, our case in which a patient presented symptoms of the so-called ophthalmoplegic migraine. In this case there was involvement of the optic, trigeminal and oculomotor nerves on the affected side resulting from pressure of a mucocele in the sphenoid sinus, which had eroded the left side and floor of the sella. Treatment consisted of removal of the anterior wall of the mucocele by the intranasal route.

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11. Williams, H. L., and Mousel, L. H.: Diagnosis and Treatment of Chronic Disease of the Paranasal Sinuses, Ann. Otol., Rhin. & Laryng. **49**:466-489 (June) 1940.

12. Lillie, H. I., and Williams, H. L.: The External Fronto-Ethmo-Sphenoid Operation: A Critical Review of the Literature and Details of the Technic in Use at the Mayo Clinic, Minnesota Med. **18**:786-789 (Dec.) 1935.

13. Weille, F. L.: External Sinus Surgery, Surg., Gynec. & Obst. **84**:853-858 (April) 1947.

14. Morman, W. D.: Mucocele of the Fronto-Ethmoid Area: Report of 2 Cases, Ann. Otol., Rhin. & Laryng. **56**:927-931 (Dec.) 1947.

15. Turner, A. L., and others: Diseases of the Nose, Throat and Ear, ed. 4, Baltimore, William Wood & Company, 1936, p. 96.

16. Chamberlin, W. B., and Parry, T. L.: Mucocele as a Cause of Proptosis: Report of 6 Cases, Arch. Otolaryng. **18**:172-180 (Aug.) 1933.

17. Hermann, K., and Hall, I. S.: Sphenoidal Mucocele as a Cause of the "Ophthalmoplegic Migraine Syndrome," Tr. Ophth. Soc. U. Kingdom **64**:154-164, 1944.

According to Skillern,[18] mucoceles can be differentiated from pyoceles by the (1) slower rate of growth, (2) absence of symptoms of inflammation, (3) absence of tenderness, (4) firmness on palpation as opposed to the more fluctuant pyocele, (5) mild orbital complications, (6) mucoid substance found on puncture and (7) sterile secretions. Lillie and Lake[19] stated that in the differential diagnosis the following conditions must be considered: (1) orbital tumors, (2) malignant neoplasia, (3) meningiomas, (4) osteomas, (5) cholesteatomas, (6) hemorrhagic cysts, (7) oil cysts, (8) dermoids, (9) gummas, (10) localized osteomyelitis and (11) mucoceles involving the lacrimal sac.

In a group of 100 patients with mucoceles or pyoceles of the ethmoid and frontal sinuses studied by Lillie and Lake,[19] 40 complained of pain or headache alone over the involved region. Eleven noted pain and nasal discharge, and 10 complained of nasal discharge but no pain.

The treatment of mucoceles is surgical, but opinions in the literature are at variance as to the technics to be used. Goodyear[20] favored simplicity and recommended an intranasal approach. Turner,[6] Simpson[21] and Chamberlin and Parry[16] recommended the external approach. Lillie and Lake preferred the external approach when there was neither intranasal nor orbital extension and when there was orbital extension only. When intranasal manifestations with or without orbital signs were present, they preferred the intranasal operation followed by an external operation, if necessary.

REPORT OF CASE

The patient, a white woman aged 34, registered at the Mayo Clinic on Oct. 10, 1944 because of pain on the right side of the head and face associated with nasal stuffiness and discharge. She gave a history of having had "sinus trouble" all her life and stated that damp weather or inhalation of dust set off attacks of sneezing with nasal obstruction and the sensation of pressure in her head. Several polypectomies had been performed, and in 1941 the right antrum had been explored because of "infected bone." Three weeks prior to registration at the clinic she had had an operation on the right frontal sinus because of severe pain in that region. Further questioning revealed that the pain in the right side of the face nearly always appeared as the result of changes in temperature and usually extended to the right ear, neck and shoulder. When pain was present, there was excess lacrimation on the right side.

Examination showed polypoid degeneration of the nasal mucosa and hypertrophy of the posterior tips of the turbinate bodies on the left, with blocking of the left choana. There was a patent nasoantral window on the right. Bilateral antral lavage gave negative results. Roentgenograms of the paranasal sinuses disclosed diffuse polypoid changes and poorly developed frontal sinuses. A routine roentgenogram of the thorax, a urinalysis, a blood count and serologic tests indicated nothing of significance. A diagnosis of "vasodilating pain syndrome" was made, and the patient was dismissed with instructions to use vasodilation treatment with monoethanolamine nicotinate (nicamin®) as the vasodilating agent.

The patient returned on May 24, 1948, stating that the pain in her head had gradually subsided over a period of months after her dismissal in 1944. Since 1948 she had required

18. Skillern, R. H.: The Catarrhal and Suppurative Diseases of the Accessory Sinuses of the Nose, ed. 3, Philadelphia, J. B. Lippincott Company, 1920, p. 344.

19. Lillie, H. I., and Lake, C. F.: Mucoceles, Pyoceles and Cystic Degenerative Lesions of the Frontal and Ethmoidal Sinuses, Tr. Am. Laryng. A. **69**:110-121, 1948.

20. Goodyear, H. M.: Mucocele in Frontal and Ethmoidal Sinuses: Simplified Surgical Treatment, Ann. Otol., Rhin. & Laryng. **53**:242-245 (June) 1944.

21. Simpson, W. L.: The Indications for the External Ethmo-Spheno-Frontal Sinus Operation, South. M. J. **29**:594-603 (June) 1936.

polypectomies on one or the other side of her nose about twice yearly. She had continued to notice the usual nasal congestion and rhinorrhea from dust and changes in temperature. One year prior to her return she had noticed slight protrusion of the left eye and diplopia. She stated that vision on the left had been progressively failing and that she had had progressively severe "cutting" pain over the left eye and left temple.

The left nasal cavity was filled with a firm, elastic, fixed mass, which caused the eye to protrude forward and laterally. The extraocular motions were satisfactory, but the patient could read only large print. The choana was blocked by a large dense mass of tissue, the surface of which had a grapelike configuration. The examining consultant's impression was that this was an expanding polypoid mass but that it was probably malignant.

Hyperopia and vision were considerably improved with plus lenses. Visual fields were normal, as were the pupils and the ocular reflexes. The ocular fundi appeared normal except for vertical corrugations of the left retina; these corrugations were interpreted as indicating pressure posterior to the eye. A roentgenogram of the head was reported to reveal "extensive malignant destruction of the floor and dorsum sellae, and the body of the sphenoid bone;

Fig. 1.—*A*, destruction of the sella turcica and of the body of the sphenoid bone. *B*, extensive absorption of bone in the ethmoid area and medial wall of the left orbit.

destruction of the tips of both petrous processes, more marked on the left; extensive destruction of both ethmoid areas and medial wall of the left orbit; opacity of both antrums, and a tumor mass in the left side of the nose" (fig. 1).

On the presumptive diagnosis of an inoperable malignant neoplasm based on the roentgenologic diagnosis arising in the sphenoid sinus, roentgen therapy was instituted.

The patient returned again on Jan. 1, 1950. She felt well and had gained some weight since dismissal a year before. There was little, if any, change shown on physical examination, however. A roentgenogram of the head indicated some recalcification of the floor of the sella and that the area of destruction in general was less than on May 25, 1948 (fig. 2). After reconsideration in view of the benign behavior of the lesion, the decision was made to explore it.

On Jan. 28, 1950, an external frontal incision was made on the left side. The lamina papyracea and the floor of the frontoethmoid cells had been resorbed, but there was no infiltration of the periorbita. The ethmoid sinus was greatly widened by pressure, and the whole space was filled with a mass of gummy, rubbery mucus (fig. 3). This mass was removed in its entirety. It was found that the dura was exposed over the entire roof of

the sphenoid and part of the roof of the left ethmoid labyrinth, an area of dura about 4 by 2 cm. in all being uncovered by the disease. The material was completely removed. The middle turbinate was preserved, and the opening into the sphenoid, which was rather wide as a result of pressure of the mass of mucus, was further enlarged. The frontal wound was closed with Zytor and silk. A Caldwell incision was made just above the margin of the teeth, and the antrum was opened. The canine fossa was very thin. It was seen that the antrum was filled with the same type of material that was present in the other sinuses. The lining membrane was carefully stripped from the bone and, in the posterior half of the sinus, from the periosteum, as the bone had been resorbed, apparently by pressure. The mucous mass was removed as a solid ball, and the mucosa was preserved separately and sent to the path-

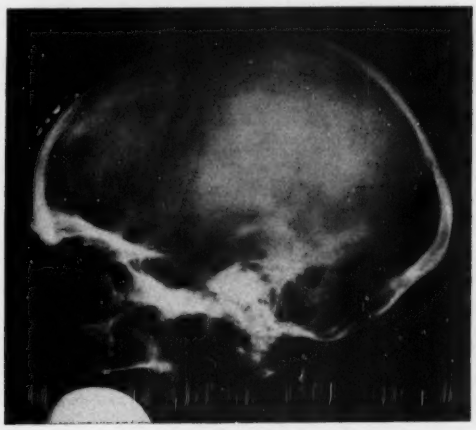

Fig. 2.—Condition immediately prior to operation, showing some recalcification of the sella.

Fig. 3.—Thick, rubbery mass of inspissated mucus filling the left antrum.

ologist for a fresh frozen section and a possible diagnosis. Material was also sent from the sphenoid and ethmoid areas. The Caldwell incision was closed with plain surgical gut. The frontoethmoid sinuses and the maxillary sinuses were each packed with a continuous strip of petrolatum gauze, the one in the frontoethmoid area being made up of two strips of ordinary length tied together. The patient was given 1,000 cc. of blood and anticoagulant acid citrate dextrose solution U. S. P. (A.C.D. solution) through the right saphenous vein. The pathologist reported that tissue from the left frontal sinus, left antrum and left sphenoid sinus consisted of inflammatory mucous membrane with dilated mucous glands together with masses of inspissated mucus.

The patient was given 600,000 units of procaine penicillin daily during the postoperative period. Convalescence was smooth, and she was dismissed on the ninth postoperative day,

at which time she felt well. She returned to the hospital the following morning, however, because of the sudden onset the night before of sharp, lancinating pain in the region of the left eye, which extended back to the left ear. She was afebrile. Several large crusts of firm mucus and clotted blood were removed from the left nasal chamber. Recalling her history of vasodilating pain, 1 cc. (2 mg.) of dihydroergotamine was administered intramuscularly. Within 30 minutes the pain subsided. The patient remained in the hospital an additional 17 days. She was given a total of 1,200,000 units of procaine penicillin daily by the intramuscular route, and for four days 1,500 mg. of aureomycin was administered orally each day (total, 6 Gm.) as prophylaxis against intracranial complications. The last week of this hospitalization was due to her complaint of suprapubic pain, which sometimes extended to the sacral region. No completely satisfactory explanation was found for this. The pain subsided prior to dismissal from the hospital on February 24 and from the clinic on February 25.

When the patient returned for observation four months later, all the sinuses were dry and free from secretion.

This case indicates, then, that true mucoceles of the texture of those found in the ethmoids and frontal sinuses may occur in the maxillary sinus.

Mucoceles in the sphenoid sinus, although they rarely occur, may develop and expand rapidly and produce extensive destruction of bone simulating that of a malignant neoplasm. These observations must be considered in differential diagnosis.

Clinical Notes; New Instruments and Technics

NEW SUCTION AND IRRIGATION INSTRUMENT

ROBERTO MACHADO, M.D.
HABANA, CUBA

It is a well known fact in mastoid surgery, whether it be a fenestration, a simple or radical mastoidectomy, or the surgical removal of polyps of the ear canal, that the only way to keep the surgical field "spick and span" is by the use of intermittent or continuous suction and irrigation, a method which has finally displaced the old sponge-drying technic used years ago.

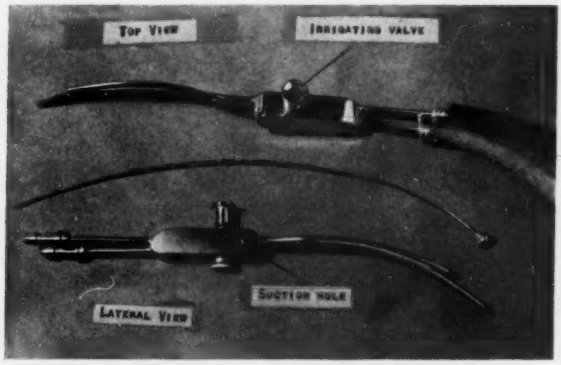

Fig. 1.—New suction and irrigation instrument.

Fig. 2.—The instrument in use.

To perform this type of operation a considerable amount of time is sometimes required, and any modification which may bring a saving of time and instrument handling should be considered an improvement in this particular field of surgery.

The instrument that I am now presenting as a contribution to otology has nothing new in its principle but is new in its shape (fig. 1). By combining in a single instrument the irrigation and the suction needed in the surgical field, a substantial saving of time is achieved. This instrument is held like a fountain pen (fig. 2) and allows the surgeon the use of his other hand, which remains free, to work with the curet or the dental burr. The surgical field may be irrigated with a saline solution or aspirated, or the two procedures may be done at the same time.

At first the instrument was used only for cadaver work, to permit one hand to remain free in order to save time and instrument handling. Later I started to use it on patients in the regular operative room technic, with good results.

I present it as a useful and practical instrument for any surgical procedure which requires suction and irrigation.

Soledad 205.

REDUCTION OF NASOFRONTAL ANGLE IN RHINOPLASTY

Disarticulation Technic

HARRY NEIVERT, M.D., D.Sc.
NEW YORK

The creation of a pleasing glabellar depression taxes the ingenuity and skill of all rhinoplastic surgeons. Each operator uses the method found most suitable to his hands. The following technic was devised and used by me in 1946.

After the usual elevation of soft tissues, the saw is placed on the approximate line, as shown in the figure, and the nasal bones and septum are cut across. The cuts are continued upward into the solid bone with a chisel to the region of the frontonasal suture. The septum as well as the nasal bones must be cut through. The cartilaginous attachments are severed as usual. A heavy septal forceps (such as the Köffler) is applied so that one blade is on the center of the dorsum and the other in the cut anterior to the separated septum, straddling the partially severed anterior half of the nasal bridge. With a firm grip and gentle rocking, this mass of bone is separated from the articulation. This method creates no bone shavings or irregular grooves. The bone comes away in one piece.

In some cases it may be necessary to insert a graft along the midline of the dorsum, if it appears too broad after the lateral osteotomy. This procedure is best done some time later. At times, it may be advisable to take out wedges of the solid block, especially in a very broad nose.

(*Illustration Appears on Opposite Page*)

Front and side views of patient before and after operation with use of the disarticulation technic.

TWO NEW INSTRUMENTS

PAUL G. BUNKER, M.D.
ABERDEEN, S. D.

Tracheotomy Decannulating Stopple

Not infrequently, even after the usual decannulating measures are carried out in a tracheotomized patient, it is necessary to reintroduce a tracheotomy cannula hurriedly to relieve laryngeal obstruction. In this situation, one is reluctant to introduce a bronchoscope for temporary relief from the obstruction while the cannula is being reinserted, for fear of aggravating the existing edema. The rapidity with which a tracheotomy fistula will close once the cannula is left out is surprising. The fistulous tract, being lined with exuberant granulation tissue, oozes from every point at the slightest touch. This fact makes the insertion of the tracheotomy tube a messy and time-consuming procedure under the stress of the emergency.

To obviate this difficulty, this decannulating stopple was designed. In reality, it is only a stub tracheotomy tube with the upper and lower ends sealed off. It comes in two sizes, 1 and 2. The length is so designed that it reaches only to the

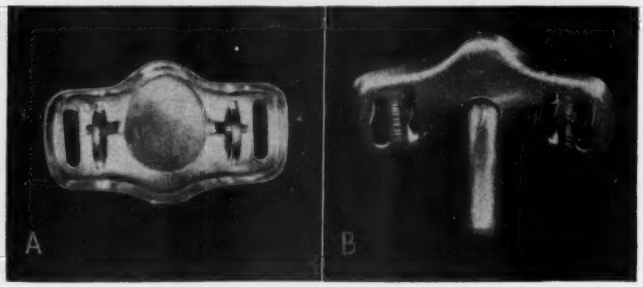

Fig. 1.—Tracheotomy decannulating stopple. *A*, superior view. *B*, inferior view.

tracheal opening without invading the lumen of the trachea. Other instruments designed for this purpose extend into the trachea, thus adding a mechanical block to normal respiration. In a patient with a thin neck it might be necessary to add additional dressings to keep the lower end of the stopple out of the trachea.

The stopple is used only after the usual decannulating measures have been carefully carried out. It is now my routine practice to have the patient wear the stopple for two or three days after this has been done.

The ordinary tracheotomy tube actually is a foreign body within the trachea and, as such, provokes a limited reaction within the trachea. If the stopple is worn for several days this residual inflammation is allowed to subside and obstruction is unlikely to reoccur. However, should signs of obstruction reappear, it is a simple matter to remove the stopple and to reinsert quickly a tracheotomy cannula, with lifesaving effect.

In young children, the stopple has a definite psychologic advantage. These patients fully realize their dependence on a tracheotomy cannula and become upset and excited at its removal. This reaction can bring on laryngeal spasm with return of the obstructive signs. By wearing the stopple, the patient is still cognizant of a tube in the neck, and, as a result, the laryngeal spasm is less likely to occur.

Modified Laryngeal Cup Forceps

This laryngeal cup forceps is designed for use in the removal of those small cord tumors in which it is necessary to keep the opposite cord out of the surgical field. It consists of a ¼ inch (0.64 cm.) extension beyond the cup of a standard laryngeal cup forceps. This extension is introduced between the cords and serves as a retractor until the tumor comes within the range of the instrument. When used in the lateral plane, it holds the opposite cord out of the way. In the anteroposterior plane it is wide enough to hold both cords apart. The instrument can be used

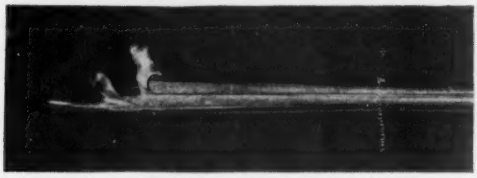

Fig. 2.—Modified laryngeal cup forceps.

satisfactorily through any style of laryngoscope. This forceps also makes possible a more accurate removal of the opposite cord tumor by elimination of a free-swinging tip. With the tip fixed in position against the normal cord, exact application can be made, thereby permitting complete removal of the tumor without trauma to the affected cord. It does not supplant the standard instruments used for this purpose, but it is hoped that it will prove to be a useful addition, especially in removing those pedunculated tumors that tend to drop below the cords during inspiration.

These instruments may be secured from G. Pilling & Co., Philadelphia.

124 South Main Street.

Progress in Otolaryngology

Summaries of the Bibliographic Material Available in the Field of Otolaryngology for 1949

THE PARANASAL SINUSES

SAMUEL SALINGER, M.D.
CHICAGO

This review covers all the articles listed in the *Quarterly Cumulative Index Medicus* for the second half of the year 1949, plus all the articles published in the ARCHIVES, the *Annals of Otology, Rhinology and Laryngology* and *Laryngoscope* for the entire year. The remainder of the material covering the first half of 1949 was not available because the *Quarterly Cumulative Index Medicus* for that period had not been compiled. When this list is made available the material therein listed will be added to a subsequent review.

PHYSIOLOGY, PATHOLOGY, BACTERIOLOGY

Ingelstedt and Ivstam[1] attempted to discover the source of nasal secretion in laboratory animals as well as in human subjects by injecting potassium fluorescein intravenously and drawing off samples of nasal secretion by means of cotton-wool swabs at intervals applied to the inferior turbinate bodies. These samples were dissolved in a tenfold quantity of a 2 per cent solution of sodium bicarbonate, and the degree of fluorescence was observed by means of radiation from a mercury vapor lamp. Since no fluorescence was observed in any of the specimens taken from 50 normal subjects, the authors conclude that nasal secretion is normally derived solely from the mucous glands.

After these experiments in normal subjects, the same authors[2] investigated the nasal secretions of patients with acute infection, acute allergy and chronic nasal allergy. The results were that a bright fluorescence was observed in the secretions of the acute cases, whereas in the cases of chronic allergy this phenomenon was not seen. The conclusion reached was that only in acute conditions does a transudate appear in nasal secretions which otherwise are entirely the result of glandular secretion.

Tremble[3] describes the secretion of nasal mucus, its physical attributes and the method of its propulsion backward to the pharynx. He also discusses the function of mucus and the factors which influence its amount, consistency and rate of propulsion. Postnasal discharge in most cases is harmless, although in certain persons it becomes an annoyance and frequently a cause of concern. It becomes a matter of importance only when pathogenic bacteria are introduced which give rise to infection; this situation is often complicated by a virus, and the patient complains of frequent acute infections of the upper respiratory tract. The author finds that antihistamines frequently act favorably in these cases by reducing the early edema. Chemotherapy, to be effective, has to be systemic rather than local. There is still great need for the development of an antivirus.

1. Ingelstedt, S., and Ivstam, B.: The Source of Nasal Secretion in the Normal Condition: Fluorescein Tests, Acta oto-laryng. **37**:446 (Oct.) 1949.

2. Ingelstedt, S., and Ivstam, B.: The Source of Nasal Secretion in Infectious, Allergic and Experimental Conditions, Acta oto-laryng. **37**:451 (Oct.) 1949.

3. Tremble, G. E.: The Dynamics of Nasal Mucus, Laryngoscope **59**:639 (June) 1949.

Ballenger[4] reviews previous experiments on animals relative to the behavior of cilia in various conditions of health and disease. He made a number of studies of tissue removed from the nasal septum or the trachea of rabbits and examined under the ultropaque microscope. The author was particularly interested in the effect of an induced allergic state on ciliary activity, using horse serum in various dilutions from 10 to 50 per cent in saline solution. He found that the ciliary function was not materially depressed either by the horse serum or by the histamine used locally or intravenously. This experiment corroborates the clinical observations reported by Ornston and Tremble, who found no difference in ciliary function between nonallergic and allergic mucosae.

Schwarz[5] discusses the incidence of orbital complications of sinus infections and stresses the role of inherited tendencies which are inherent in the mesenchymal tissues. There is a wide variability in the quality of the mucosa and submucosa, which accounts for the manner in which it reacts to invaders. As an example, he cites a case of edema of the lids due to an acute exacerbation of a chronic ethmoiditis in a child of 8. Analysis of the family tree for four generations revealed an unusually large percentage of cases with a history of chronic sinus and ear infections necessitating operative procedures in many of them.

The author states that reaction to invaders may be alterative or productive. In the latter case, the tissues have the power to react by the production of resisting connective tissue offering a barrier to the infection. In the alterative type, this inherited reactivability is at a minimum, which accounts for the involvement of multiple sinuses and the tendency for the condition to spread to the orbit.

Schmidt[6] performed some experiments on 21 guinea pigs to determine the effects of dust inhalations on the nasal mucosa and sinuses. The animals were kept in chambers into which quartz, calcium, magnesium and other minerals were insufflated in dust form to a concentration of 80 mg. per cubic meter. The animals were exposed to this dust for one hour daily over a period of from 34 to 518 days. Analysis of the postmortem findings disclosed an extensive pathological condition in the sinuses in 12 cases, bilateral in nine. The longer the exposure, the greater the degree of change. The histological examination showed extensive empyema. Dust cells impregnated with dust, round cells, desquamated epithelium, cylindrical cells and bacteria were found in abundance. The deeper tissues were infiltrated with round cells, forming a layer in which numerous leukocytes were also present. In some cases the periosteum was thickened and there were areas of bone destruction.

On the basis of these findings, Schmidt argues that men working in industries in which there is a high concentration of dust in the air are liable to have similar pathological conditions and that, therefore, regular systemic examinations should include a study of the sinuses.

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4. Ballenger, J. J.: A Study of Ciliary Activity in the Respiratory Tract of Animals, Ann. Otol., Rhin. & Laryng. **58**:351 (June) 1949.

5. Schwarz, M. K.: Die Voraussetzungen einer spontanen Beteiligung von Lidern und Orbita bei den Erkrankungen der Nasennebenhöhlen, Klin. Monatsbl. Augenh. **114**:535, 1949.

6. Schmidt, W.: Das Nasennebenhöhlenempyem als Berufskrankheit infolge Staubinhalation, Pract. oto-rhino-laryng. **11**:282, 1949.

Savolainen,[7] in the course of two years, found yeast fungi in the cerebrospinal fluid of 16 otorhinological patients, of whom 13 had a purulent meningitis, two a serous meningitis and one a normal fluid except for the fungi. Yeast fungi were found in 20 per cent of all recognized cases of meningitis. Cultures were productive in seven cases, yielding Candida albicans. This same fungus was encountered in the nasal cavities and auditory canals in 30 per cent of 30 healthy women.

It seems apparent that the presence of fungi in the cerebrospinal fluid has little to do with the pathogenicity or severity of the case, being merely a secondary invader that gains access either by way of the operative breach or by the lymph and blood channels from the ear or the olfactory canals. These fungi are usually penicillin resistant, but in some cases they will yield to the sulfonamides.

Urdal and Berdal [8] contribute a study of the bacterial flora in 45 cases of acute sinusitis and 36 chronic cases, in seven of which the condition was fetid. Great care was exercised to exclude contamination from the nasal cavity, and a special technic was used to demonstrate Hemophilus influenzae. Diplococcus pneumonia occurred alone in 25 cases and with H. influenzae in seven. H. influenzae occurred alone in 14 cases and was associated with pneumococci, hemolytic Streptococcus or Klebsiella ozaenae in 11. Hemolytic Streptococcus was found alone in two cases and with H. influenzae in three. In 20 cases the secretions were sterile. In the cases with fetid secretions there was shown a predominance of anaerobic gram-negative rods belonging to the family XI: Bacteriaceae (Bergey, fifth edition) and anaerobic nonhemolytic streptococci. A comparison between direct smears and cultures showed a striking degree of correspondence, which would indicate that the microbes originated in the sinus under investigation.

DIAGNOSIS

Dargent, Papillon and Gaillard [9] point out the advantages of pictures taken in the Hirtz position through the mandibular arch. It shows the posterior ethmoid and sphenoid sinuses in line, brings out the pterygomaxillary region clearly and demonstrates the posterior wall of the antrum. Two pictures with accompanying diagrams show clearly the destruction of the last-named structure in one case and the involvement of the pterygomaxillary and the sphenoid sinus in another. The more accurate the delineation of the extent of a malignant growth, the better the planning of therapy.

Bargy [10] reports an interesting case in which the roentgenographic findings were mysterious and inexplicable. The patient had complained of pain in the upper jaw for a long time. Transillumination showed a cloudy antrum. Roentgenograms revealed a shadow in the lower portion of the sinus which had a strangely mottled appearance. Puncture and washing gave negative results. A Caldwell-Luc operation disclosed a quantity of foul caseous material in the sinus but no pathologic

7. Savolainen, T.: On the Presence of Yeast Fungi in the Cerebrospinal Fluid in Oto- and Rhinogenic Meningitis, Acta oto. laryng. **37**:339 (Aug.) 1949.

8. Urdal, K., and Berdal, P.: The Microbial Flora in 81 Cases of Maxillary Sinusitis, Acta oto-laryng. **37**:20 (Feb.) 1949.

9. Dargent, M.; Papillon, J., and Gaillard: L'incidence de Hirtz dans l'étude des tumeurs malignes du sinus maxillaire, J. de radiol. et d'électrol. **30**:573, 1949.

10. Bargy, P.: D'une image atypique d'opacification d'un sinus maxillaire, J. de radiol. et d'électrol. **30**:551 (Feb. 8) 1949.

condition in the mucosa or the bone. This material was examined roentgenographically; the same mottled appearance was disclosed as that in the picture of the sinus before operation. On questioning the patient concerning medicaments used in the nose, it was found that one of them called Metosyl, a vitamin preparation, had been used for nearly two years. Roentgenograms of a sample showed the same typical shadows. It was thought that the small quantities of the powder remaining in the nose had been introduced into the sinus during the course of several previous antrum punctures. The possibility of the preparation having been aspirated through the ostium on inhalation was not mentioned.

Bertolotti [11] calls attention to the publications of Cetelli over a period of 25 years pertaining to the close relationship between inflammatory processes in the epipharynx and sinuses and the pituitary function, particularly in the preadolescent stage. He reviews some of the supporting evidence presented by other Italian authors demonstrating the spread of infection from the sinuses through the intervening tissues to the endocranium, resulting in involvement of arachnoid spaces and the diencephalohypophysial areas. He asserts that the subject has not received the attention it merits because of hesitancy or timidity of roentgenologists to evaluate their findings and because of reluctance on the part of rhinologists to accept roentgenologic reports that are not substantiated by the usual clinical examination. He makes a plea for closer cooperation and more detailed study of cases of pituitary dysfunction from the point of view of possible relationship to an underlying perisinusitis.

Dony[12] reviews the usual diagnostic procedures, with comments concerning their respective values. In addition to the use of transillumination and roentgenograms, he mentions the pressure changes in the respiratory cycle, as measured by the manometer, as a means of determining the patency of the ostium. Less than 6 mm. of water pressure on inspiration would indicate an obstruction at the ostium, a sinus partition or a cyst. Also, he calls attention to the value of instilling a 5 per cent solution of azosulfamide to determine the resorptive activity of the mucosa. Normally, it should appear in the urine within a half hour and be entirely eliminated in 12 to 16 hours. Delay in this process indicates a pathological state of the mucosa. He also describes the various methods of introducing contrast media and interpretation of the resulting pictures.

Emerson and Grohowski[13] show pictures of the equipment designed by Dr. Eugene Caldwell in 1907 for skull roentgenography, which is still in use. The patient is recumbent on the table with head projecting beyond the end and resting on an adjustable head rest, by which various angles of projection are obtained.

COMPLICATIONS: INTRACRANIAL, ORBITAL AND PULMONARY

Ewertsen [14] reports two cases of fatal meningitis, due to isolated acute sphenoiditis, in which the early diagnosis of the initial focus was obscured by the rapid

11. Bertolotti, M.: L'entità clinica e radiologica della perisinusite profunda è forse ben conosciuta? Arch. radiol. **23**:29 (March) 1949.

12. Dony, H.: Comment explorer et traiter les cavities para-nasales, Rev. méd. Liège **4**:459 (Aug. 1) 1949.

13. Emerson, E. B., Jr., and Grohowski, A. L.: The Caldwell Sinus Apparatus: A Historical Note, Med. Radiog. & Photog. **25**:56, 1949.

14. Ewertsen, H. W.: Isolated Acute Sphenoiditis Causing Meningitis, Acta oto-laryng. **37**:563 (Dec.) 1949.

development of complications. In the first case a mild rhinitis of about two weeks' duration led to orbital and meningeal symptoms. An external ethmoid operation was performed, but no pus was encountered. A probe thought to have been introduced into the sphenoid sinus was, at autopsy, found to have missed this cavity, which contained thick greenish pus. Thrombophlebitis of veins extending into the cavernous sinus and brain was clearly demonstrated.

In the second case the meningeal symptoms appeared within 36 hours of the onset of an acute rhinitis. Orbital involvement, otitis media and trismus complicated the picture. Pus was seen in the nose and pharynx. The symptoms suggested a pharyngomaxillary infection as well as mastoiditis. The mastoid was opened and nothing abnormal was found. The neck was then opened and probed, with no result. Later, the jaws were forced apart, and an incision in the lateral retropharyngeal area released a large quantity of pus. Autopsy disclosed the sphenoid sinus filled with pus and an extension through the roof into the pituitary fossa, which, along with the surrounding area, was also bathed in pus.

The author points out the importance of constant occipital pain or pressing pain behind the eyes as a symptom suggesting sphenoid involvement occurring during the early stages of an acute rhinitis. The sphenoid should in such cases be carefully investigated. The sinus can be successfully probed in practically every case if the middle turbinate is pressed outward with a long Killian speculum. Early drainage might forestall the extension of the infection. Such cases as the ones reported again emphasize the futility of antibiotics in the presence of an undrained focus.

Mufson and Wagner [15] report a case of subdural empyema due to acute frontal sinusitis in a woman of 29. The early symptoms were severe frontal headaches, lapses of memory and the later ones were vomiting and contralateral monoplegia. Soon after admission to the hospital, she became comatose and manifested a hemiparesis, jacksonian seizures and pupillary changes. A burr hole was made in the frontal bone 4 cm. above the brow, releasing a thin, brownish turbid fluid followed by green creamy pus. This matter was traced to the subdural space. The opening was enlarged and drainage instituted. Antibiotics were administered. The symptoms improved for several days, when the patient again became stuporous. Brain abscess was suspected, but probing failed to disclose any pus. Improvement followed over a two week period, at the end of which time roentgenograms disclosed an area of osteomyelitis in the frontal bone. A wide excision removing considerable necrotic bone uncovered a large epidural accumulation of pus. The recovery from then on was uninterrupted.

[*Reviewer's Note.*—It is interesting to note that the history states that the initial severe symptoms followed closely on the removal of a polyp and a portion of the middle turbinate three weeks after the acute upper respiratory infection.]

Rudberg and Sjöberg,[16] in analyzing their results in nine cases of meningitis, conclude that the intrathecal administration of penicillin is absolutely essential and in some cases must be given by cisternal rather than lumbar puncture. Their experience has shown that in some cases the barrier between blood and cerebro-

15. Mufson, J. A., and Wagner, M.: Acute Subdural Empyema Secondary to Frontal Sinusitis, Arch. Otolaryng. **51**:535 (April) 1950.

16. Rudberg, R., and Sjöberg, A.: On Prognosis and Therapy in Oto-Rhinogenous Meningitis, J. Laryng. & Otol. **63**:446 (Aug.) 1949.

spinal fluid is not readily penetrated, and therefore the intravenous and intramuscular route may fail to carry the drug to the infected tissues. They advise concentrations of not more than 1,000 units per cubic centimeter for the intrathecal administration of penicillin, and advise giving two injections a day in certain cases for totals of 10,000 to 20,000 units per day. At the same time they continue the intramuscular injections of penicillin and sulfamerazine by mouth or intravenously. This therapy is continued until at least three spinal fluid cultures are returned sterile. The intrathecal injections daily are then given for at least four or five days. The records of their nine cases show total dosages of penicillin intramuscularly as high as 71 million and intrathecal dosages up to 500,000 units.

Leegaard and Boysen [17] report three cases of rhinogenic meningitis. One patient who also had a frontal lobe abscess recovered with combined penicillin and sulfadiazine therapy. The penicillin was given in 100,000 unit doses intramuscularly eight times daily and intrathecally in doses of from 10,000 to 20,000 units once a day. The sulfadiazine was given orally for a total of 6 Gm. daily. The brain abscess was aspirated and a penicillin solution instilled.

Kler,[18] in reporting three cases of frontal lobe abscess secondary to ethmoiditis, comments on the natural barriers to the extension of infection cranially, such as the dense lamellar bone with few dehiscences, a rich blood supply and a lymphatic drainage in the opposite direction. As a rule, the infection is transmitted by way of direct contiguity with local osteitis and erosion. In one case, an acute infection in a child of 5 produced typical symptoms of ethmoiditis, periorbital abscess and nuchal rigidity. Exposure and drainage of the abscess disclosed necrosis of the roof of the ethmoid, leading to an extradural abscess with a fistulous tract, leading to a subcortical abscess. Drainage and chemotherapy accomplished a cure.

The two cases of chronic abscess occurred in adults and, in both instances, there were severe headache and papilledema. Kler also found that the encephalograms were valuable aids in the diagnosis. Fortunately, in most cases of this type, encapsulation of the abscess has already taken place, and if the focus and site of extension are uncovered, they usually lead to the intracranial collection, which, when adequately drained, offers a good prognosis if chemotherapy is given in sufficient amounts.

Winborn [19] reports five cases of frontal sinusitis complicated by osteomyelitis, extradural abscess and orbital involvement. Good results were obtained in all through the use of antibiotics in adequate doses and through exenteration of all diseased tissues. It is pointed out that surgical procedure should be delayed as long as possible in order to permit localization and control of the infection through the antibiotics. In the acute stages simple drainage via trephine of the floor of the sinus is advisable. The surgical approach will depend on the extent of the disease, which must be uncovered and eliminated to the fullest.

The antibiotics should be continued for several weeks after operation.

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17. Leegaard, T., and Boysen, F.: Behandling av intrakranielle Komplikasjoner ved ore— og neselidelser med penicillin og sulfanomider, Tidsskr. norske laegefor. **69**:527 (Oct. 1) 1949.

18. Kler, J. H.: Abscess of the Frontal Lobe Secondary to Ethmoiditis, Arch. Otolaryng. **49**:125 (Feb.) 1949.

19. Winborn, D. C.: Frontal Sinus Infections: Complications and Management, Ann. Otol., Rhin. & Laryng. **58**:280 (March) 1949.

Simonton and Anthony [20] report five cases of meningitis following the removal of polypi and ethmoid exenteration. Headache was the prominent early symptom, becoming very pronounced within 36 hours, and was followed by the other classic symptoms. Penicillin was found to be less effective than the sulfonamides. These drugs have to be given in adequate amounts and for a long enough period to avoid recurrences after the initial subsidence of symptoms. Symptoms of acute abdominal disease appeared in two of the cases, posing a serious problem in diagnosis, inasmuch as rigidity of the abdominal wall is a frequent finding in meningismus. In one case operation revealed a gangrenous gallbladder. In another case the symptoms suggested a perforated ulcer. However, after a period of several days, the abdominal symptoms cleared up. The authors suggest that the pathways to infection of the endocranium must be along preformed channels such as veins and nerves of perineural lymph channels or by way of trauma to the cribriform plate.

According to Piquet,[21] exteriorization of a sinus infection may be either in the form of an edema or a suppuration. The former is oftenest seen in infants and yields to antibiotic therapy combined with minimum intranasal drainage. Edema in older children or adults is likely to be symptomatic of a subperiosteal abscess, necessitating incision and drainage. Should one fail to encounter pus, one should proceed either to intranasal drainage or to radical external surgery. Antibiotics are, of course, given both before and after operation.

Frank suppuration in the orbitopalpebral area may mean a possible osteomyelitis. In other cases it may indicate orbital involvement with possible danger to the eye. Operative procedure in these cases must be thorough and complete.

The author is opposed to two-stage operations formerly advocated. He believes that the infection can be localized by antibiotics and then completely cured by radical surgery in one stage. He advises the Lima transantral ethmoid operation when these areas are involved, but cautions against expecting a concurrent frontal infection to recede. One cannot hope for a cure in such a case unless the frontal sinus is dealt with separately.

Vieweg [22] stated (in his English abstract):

> The diagnostics of the sinus-lung syndrome is in reality mainly dependent on the diagnostics of maxillary sinusitis. In this respect fluoroscopy of the maxillary sinus has proved to be a satisfactory method in practice. Among acute infections of the air-passages the incidence of sinusitis was 17.09 ± 1.30 per cent at an investigation of some 1,200 civil servants in 1947-1948. During a period of epidemic influenza A in January-February 1947, no definite increase of the incidence could be established. The lung specialist, examining "cough-cases," should not neglect to screen the maxillary sinuses, and the practitioner should not fail to draw the roentgenologist's attention to them.

Torgersen [23] refers to his two previous papers in which he discussed situs inversus in relationship to sinus disease and gene factors affecting the development and pathology of these organs.[24]

20. Simonton, K. M., and Anthony, W. P.: Meningitis Following Nasal Polypectomy, Laryngoscope **59**:169 (Feb.) 1949.

21. Piquet, J.: Traitement des sinusites extérioriscées ou fistuleuses, Ann. d'oto-laryng. **66**:337 (July-Aug.) 1949.

22. Vieweg, G.: Sinus-lungsyndromet i praxis, Nord. Med. **42**:1533 (Sept. 23) 1949.

23. Torgersen, J.: The Frontal Sinuses in Bronchiectasis, Acta radiol. **32**:185 (Sept. 30) 1949.

His current contribution is a comparison of the findings in 50 cases of bronchiectasis showing situs inversus or other congenital pulmonary pathological conditions with 30 unselected cases of bronchiectasis in otherwise normal persons. Examination of the frontal sinuses disclosed a definitely large proportion of small or totally absent frontal sinuses in the congenital cases. Certainly more of them showed this aplasia than was shown in the noncongenital group. He concludes further that

> to judge from the difference as to the size of the frontal sinuses in the two groups congenital bronchiectasis is a rare disease. An examination of the lungs and the frontal sinuses may indicate the relative role of hereditary and environmental factors. The most reasonable interpretation of the observations may be that the development of the upper and lower respiratory tract depends on the integrative action of a complex of genes.

After reviewing the literature on the incidence of sinus disease in children, which they cite liberally, Bjuggren, Kraepelien and Lind [25] undertook an investigation of their own on 74 presumably healthy children between the ages of 3 and 6 to determine the incidence, nature and duration of sinus disease. Half of these were home children and the rest were day nursery children of comparable social status. Allergy was noted in 6 of the day nursery children and in 5 of the home children. A heredity of allergy was found in 11 of the day nursery group and in 13 of the home group. Roentgenograms were taken on three different occasions with the following results: Of the home children with one examination the results were positive in 16 (total of 37); with two examinations, they were positive in 7, and with three examinations, positive in 3. Of the day nursery children, with one examination the results were positive in 20 (total of 37); with two examinations, positive in 11, and with three examinations, positive in 6.

Antrum irrigations supported the diagnosis of infection mostly in the cases in which the roentgenographic findings were indicated as 2 plus or 3 plus. In the group listed as one plus, the results in only five of the 43 punctures were positive.

The authors conclude that sinus infection is commoner among supposedly healthy children than is generally appreciated. Very little difference was noted in the incidence between home children and day nursery children, except that in the latter group the cases observed were more protracted.

Von der Borch [26] describes the technic of introducing a catheter into the maxillary sinus in children via an opening under the inferior turbinate body, which is practically the same procedure advocated by Shea and others some years ago. He uses a rubber tube with an inside diameter of ⅛ inch (0.32 cm.) and its end rolled back to form a glanslike bulge quite similar to the flanged tube formerly used in these cases for self-retention. It is introduced with general anesthesia and left in place for seven to 10 days, or until the washings return clear. Penicillin solutions are instilled at frequent intervals.

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24. Torgersen, J.: Transposition of Viscera: Bronchiectasis and Nasal Polyps: Genetical Analysis and Contribution to Problem of Constitution, Acta radiol. **28**:17, 1947; Genic Factors in the Asymmetry of the Viscera and the Development and Pathology of the Lungs, Heart and Abdominal Organs, Arch. Path. **47**:566 (June) 1949.

25. Bjuggren, G.; Kraepelien, S., and Lind, J.: Sinusitis in Children at Home and in Day-Nurseries, Ann. Pædiat. **173**:211 (Oct.) 1949.

26. von der Borch, R. H.: Maxillary Sinusitis in Children: A Treatment Technique, Clin. Rep. Adelaide Children's Hosp. **1**:216 (May) 1949.

OSTEOMYELITIS

Herberts,[27] in citing seven cases with one death, discusses the rationale of a combined heparin, sulfonamide and penicillin therapy with surgical procedure limited to the drainage of the sinus and evacuation of localized abscesses. Only in cases in which intracranial complications are present is one justified in proceeding to radical exenteration. His experimental investigations showed that the effectiveness of the sulfonamides was enhanced by retarding coagulation through the administration of herapin. Furthermore, he shows that penicillin possesses an advantage over the sulfonamides in its ability to penetrate fibrin and blood coagulum. An important observation is the almost uniform presence of an epidural abscess when a subperiosteal abscess is present. Emphasis is placed on the avoidance of unnecessary trauma in the acute stage, particularly in dealing with the diploetic anterior wall.

Velasco [28] reports a case of fulminating osteomyelitis complicated by meningitis and cerebral abscess in a boy of 17. The condition was due to swimming and diving at a time when the patient was suffering from an infection of the upper respiratory tract. Chill followed by pain, headache and fever were the initial symptoms, which were followed rapidly by edema, local tenderness and symptoms of meningitis. Heavy doses of penicillin and sulfonamides were administered, and on the fourth day the frontal area was explored. Almost all the left frontal bone and part of the parietal bone were necrotic, and a subdural abscess was found in the rolandic area. There was some improvement for a few days, but symptoms of cerebral involvement appeared, and 20 days later a frontal lobe abscess was drained. A week later another abscess was located and drained in the parietal area. Recovery was complete.

Velasco attributes the fulminating character of the process to a combination of factors, such as primary infection of the upper respiratory tract, diving and chilling, the spongy nature of the bone involved and the numerous ramifications of communicating vessels. The offending organism was Staphylococcus albus. During the whole period of treatment the patient received 165 Gm. of sulfadiazine and 120,000,000 units of penicillin.

Arbuckle [29] reports several cases of osteomyelitis of the frontal bone with treatment with antibiotics and operation properly timed resulting in success. While the drugs may in many cases cure an acute frontal sinusitis and prevent extension into the bone, it is always important to follow the cases closely, frequently checking roentgenograms and correlating them with the local findings. Once osteomyelitis has developed, recourse to surgical procedure will sooner or later be necessary and, once undertaken, must be complete and thorough.

Macbeth [30] discusses present day methods of dealing with osteomyelitis and presents several illustrative cases. In acute cases he uses penicillin and a sulfona-

27. Herberts, G.: Frontal Osteomyelitis: Its Treatment and Some Experimental Observations on the Effect of Heparin in Combination with Sulphonamide and Penicillin Therapy, Acta oto-laryng. **37**:321 (Aug.) 1949.

28. Velasco, R. L.: Osteomielitis fulminante del frontal complicada de meningitis y absceso cerebral metastásico, Rev. otorrinolaring. **9**:57 (June) 1949.

29. Arbuckle, M. F.: Treatment of Infection of the Frontal Sinuses and Its Complications: Illinois M. J. **95**:27 (Jan.) 1949.

30. Macbeth, R. G.: Osteomyelitis of the Frontal Bone of Rhinogenic Origin, Proc. Roy. Soc. Med. **62**:284 (May) 1949.

mide, although the dosage of the former is much less than one is accustomed to give. Operation is restricted to antrum lavage and trephine puncture through the floor of the frontal sinus, with aspiration of contents and subsequent instillations of solutions of penicillin. He advises early culturing of the secretion and sensitivity tests to determine the value of the antibiotic. A review of 37 cases in a 10 year period showed Staph. aureus in nine, anaerobic Streptococcus in eight, Staph. albus in one, hemolytic Streptococcus in two and three with sterile cultures. Attention is directed to the comparatively large number of anaerobic bacteria which might be overlooked unless proper bacterial cultures are provided.

Extensive surgical treatment is indicated when the roentgenographic findings demonstrate bone involvement and the procedure advised is the coronal incision with wide exposure and removal of bone into definitely healthy tissue. Subsequent regeneration may in some cases fill the defect, but as a rule in these cases a tantalum implant is required. The author cites cases in which the process was quiescent for a period but eventually flared up again and radical surgical procedure was required. It is important that in such cases careful check be made by frequent roentgenographic examinations. Also, it is imperative that the antibiotic therapy be continued for a sufficiently long time to insure complete cure.

MALIGNANT TUMORS

Brunner [31] contends that malignant epithelial tumors originating in the oral cavity in the region of the intermaxillary fold may develop over a period of several years before involving the mucosa clinically. These growths are often mistaken for a nonmalignant chronic osteomyelitis because they tend to grow widely through the osseous tissue. They are to be differentiated by the fact that the malignant osteomyelitis develops more and larger sequestrums, the overlying skin is less inflamed and the fistulous tracts discharge a serous or hyaline fluid with some cholesteatoma-like masses.

Two cases are reported, one of which was a squamous cell carcinoma invading the floor of the maxillary sinus and associated with infection of the frontal as well as the maxillary sinus. A probable cure was obtained through operation and radiological treatment. The other case was a papillary carcinoma, which was observed over a period of five years, having destroyed the alveolar process, the frontal process of the maxillas on both sides, both nasal bones, the anterior ethmoid bone, including the lamina papyracea, upper portion of the nasal septum and both frontal sinuses. The case assumed all the characteristics of osteomyelitis, and the correct diagnosis was not made until a short time prior to death, despite several operations for the removal of the growth.

Majer [32] reports that 75 cases of carcinoma of the nose and sinuses were observed during the period from 1933 to 1946 out of a total of 1,414 cases of malignant tumor involving the head and neck. He feels that the prognosis in these cases has improved during recent years through modern therapeutic measures. Growths involving the anterior and inferior portions of the antrum are more favorable for

31. Brunner, H.: Involvement of the Paranasal Sinuses in Tumors Originating from the Mucous Membrane of the Cheek, Oral Surg., Oral Med. & Oral Path. **2**:1235 (Oct.) 1949.

32. Majer, E. H.: Zur Behandlung der Nasennebenhöhlenkarzinome, Krebsarzt **4**:216 (Aug.) 1949.

recovery than those invading the orbital-ethmoid region. The best method of handling such cases is through radical destruction with surgical diathermy. Irradiation may be helpful in the follow-up treatment.

Tice and Beller [33] review 57 cases of malignant tumors of the sinuses treated at the University of Kansas medical center between 1931 and 1947. In 1947 the growths were primary in the antrum. The cases with a five year rate of survival numbered only 26 per cent of the entire series; this percentage is explained by the fact that a number of the cases were far advanced and considered inoperable. The treatment recommended is surgical diathermy followed by intracavity radium therapy and external irradiation. Squamous cell and undifferentiated carcinoma comprised the vast majority of the group.

Schall [34] reports five cases of highly malignant tumor of the sinuses, showing in detail the difficulty in locating the primary site of the growth and the problems involved in controlling the progress of the disease and its many complications. Radiation therapy was found to be of value when supplemented by operation and chemotherapy. The prognosis is always grave in such cases, and one finds it difficult to keep up the patient's morale, support his general economy and relieve him of often intractable pain. The case histories are instructive because of the details of management presented at various stages of the process.

Thacker [35] discusses cholesteatoma of the frontal bone, listing numerous references bearing on the pathogenesis and histology of the growth. Differential diagnosis from a variety of other lesions in this vicinity is discussed briefly, covering such conditions as dermoids, vascular tumors, mixed tumor of the lacrimal gland, neurogenic tumors, fibroma, lymphosarcoma, xanthomatosis, lymphatic leukemia and syphilis.

A case is described in which a 26 year old man had an exophthalmos since childhood with a history of previous trauma. Aside from the displacement of the bulb, there were very few other disturbances. Roentgenograms showed erosion of the roof of the orbit and opacity of the frontal sinus. Operation revealed an extensive cholesteatoma, which had eroded both walls of the sinus. The exenteration left a large defect with a persistent fistula which required a subsequent operation. Residual collections of epidermoids were found and removed. A tantalum plate was used to cover the defect. Thacker mentions the possibility of a low grade osteomyelitis resulting from the operation.

Bozzi [36] discusses the differential diagnosis of plasmocytoma and plasmacellular granuloma, based on the study of a case in which the mass involved the antrum and nasoantral wall and inferior turbinate body. He cites a number of references for and against the neoplastic character of the tumor and concludes that the growth is not a true neoplasm. The photomicrographs shown appear to substantiate his

33. Tice, G. M., and Beller, W. L.: Malignant Tumors of the Accessory Sinuses, J. Kansas M. Soc. **50**:537 (Nov.) 1949.

34. Schall, L. A.: Transitional Cell Carcinoma of the Paranasal Sinuses, Ann. Otol., Rhin. & Laryng. **58**:381 (June) 1949.

35. Thacker, E. A.: Epidermoid Tumors of the Frontal Bone, Sinus and Orbit, Arch. Otolaryng. **51**:400 (March) 1950.

36. Bozzi, E.: Sulla diagnosi differenziale fra plasmocitoma e granuloma plasmacellulare del seno mascellare, Arch. Ital. di otol. **60**:296 (July-Aug.) 1949.

claim. On the other hand, the roentgenograms in his case disclosed destruction of bone in certain areas, which is more consistent with the history of an infiltrating new growth.

The article settles nothing, although it is instructive.

In the case reported by Parkes and Burtoff,[37] the diagnosis of plasma cell tumor could not be made until the antrums were opened and the excised masses removed and examined. The symptoms were those of chronic sinusitis—nasal discharge, obstruction and sense of fulness. Roentgenograms with contrast medium showed the antrums to be almost filled with irregular masses. At operation, these appeared like chronic inflammatory tissue firmly attached to the bony walls and tending to bleed. Radiological therapy was administered postoperatively: 1500 r to each antrum and 1500 r to each zygomatic region.

Fuerste and Zuckerman [38] present a fatal case of multiple extramedullary plasma cell tumor involving the nasopharynx, duodenum and several cutaneous sites, in which the first biopsies were taken from a mass in the nose that involved the entire side of the face. Photographs show progressive extension to the orbit, frontal area and opposite side. The photomicrographs showed typical plasmocytoma cells with characteristic cartwheel arrangement of the chromatin.

Chordoma of the maxillary sinus is extremely rare, and metastases to the cervical glands are even rarer, according to Pastore, Sahyoun, and Mandeville,[39] who report a case in a woman aged 21. She presented a history of a discharging ear for 20 years and recent pain and swelling just below the mastoid region and behind the jaw. This mass was irregular, firm, nodular and moderately fixed. It was removed along with a portion of the sternomastoid muscle. The histological diagnosis by three pathologists was "indeterminate," "metastatic carcinoma" and "Hodgkins' disease . . . [with] transition to sarcoma." Shortly thereafter a number of nodes appeared in the preauricular, posterior cervical and midcervical regions. Over a period of 15 months the patient received more than 13,000 r distributed over various areas of the neck and chest. The nodes diminished in size but did not completely subside. More than a year later examination disclosed a mass filling one side of the nose, involving the antrum and extending back to the nasopharynx. A review of the previous biopsies brought about a diagnosis of "chordoma."

Numerous illustrations are shown, depicting various aspects of the growth. The lesion was pleomorphic, exhibiting sheets of large cells with vesicular nuclei, cell nests with large vacuolated central cells, syncytial masses with several nuclei and groups of large cells with granular acidophilic cytoplasm.

The patient died a few months later in another hospital, and permission for an autopsy was not obtained.

Seelig [40] reports nine cases of carcinoma of the antrum and presents a review of the literature for the past 10 years. The condition in most of the patients was quite

37. Parkes, M., and Burtoff, S.: Plasma Cell Tumor Simulating Bilateral Maxillary Sinusitis, Arch. Otolaryng. **50**:666 (Nov.) 1949.

38. Fuerste, F., and Zuckerman, S. S.: Extramedullary Plasma Cell Tumor, Arch. Otolaryng. **51**:601 (April) 1950.

39. Pastore, P. N.; Sahyoun, P. F., and Mandeville, F. B.: Chordoma of the Maxillary Antrum and Nares, Arch. Otolaryng. **50**:647 (Nov.) 1949.

40. Seelig, C. A.: Carcinoma of the Antrum, Ann. Otol., Rhin. & Laryng. **58**:168 (March) 1949.

advanced and only one survived. He finds the condition commonest after the age of 50 and more frequent in males than in females. The symptoms suggesting a malignant process are unilateral discharge, nasal obstruction, epistaxis, ulceration of the palate, paresthesia or anesthesia of the face, lacrimation, pain, external swelling, exophthalmos and diplopia. The commonest type is the squamous cell carcinoma. The therapy suggested is operation followed by irradiation.

Pinsonneault [41] reports the five year cure by roentgen irradiation alone of a carcinoma of the maxillary sinus in a man aged 64. The growth had invaded the alveolus and had broken through the gingival recess. The patient received a total of 4750 r in divided doses over a period of 11 days. The factors involved were as follows: 400 kv. at 90 cm. with 2 mm. copper and 3 mm. aluminum and a current of 4 milliamperes. It was delivered over two fields. The immediate reaction was typical, but examination four years later indicated that the lesion was healed and the skin was normal, and roentgenograms displayed no evidence of any recurrence. Histologically, the biopsies revealed an epidermoid carcinoma that was particularly radiosensitive.

Kasnetz [42] presents a report of carcinoma occurring in a man of 58 who had pain and swelling of the cheek for several weeks. The lesion involved the naso-facial angle, was tender to the touch and quite dense. The nasal chamber was filled with a purplish gray firm mass, which bled freely on manipulation. The mass extended back to the choana. Biopsy revealed a papillary adenocarcinoma. The mass was removed via lateral rhinotomy. There was no immediate recurrence up to three months.

Bergquist and Koch [43] discuss the problem of malignant granuloma very thoroughly, analyzing all the evidence heretofore presented in the literature and adding several constructive comments based on a study of two cases of their own. The malignant nature of the growth is attested to by some of the sections which resembled sarcoma as well as by the widespread metastases observed in their cases. Furthermore, the fact that in one case a decided regression was noted in the primary growth following the intensive application of deep roentgen ray therapy seems to support their contention. They suggest that if such therapy were applied early enough it might be possible to control the neoplasm before it got out of hand.

Schoolman and Anderson [44] report six cases of malignant melanoma involving the nose and sinuses. They claim to have found only 38 similar cases previously reported in the literature. Treatment with nitrogen mustard and irradiation seemed to yield better results than cautery and diathermy. Although a cure was not obtained in any of the cases, extreme regression was noted in several as a result of the therapy.

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41. Pinsonneault, G.: Cancer du sinus maxillaire guéri par roentgentherapie (observation personnelle), Union méd. du Canada **78**:816 (July) 1949.

42. Kasnetz, J.: Primary Carcinoma of the Ethmoid Sinus, Eye, Ear, Nose & Throat Monthly **27**:378 (Aug.) 1949.

43. Bergquist, B., and Koch, H.: Contribution to the Question of Granuloma Gangranescus, Acta oto-laryng. **37**:405 (Oct.) 1949.

44. Schoolman, J. S., and Anderson, H. W.: Malignant Melanoma of the Nose and Sinuses, Ann. Otol., Rhin. & Laryng. **59**:124 (March) 1950.

Schmidt [45] reports a case of cylindroma in a man of 70 that developed in the frontal sinus, causing destruction of the posterior and inferior walls of the sinus, invading the orbit, displacing the bulb and destroying the inferior wall of the orbit. Metastases were diagnosed in the lung and liver through roentgenograms and physical signs, although there was no proof because an autopsy was not obtained. A typical photomicrograph is shown.

Smith and Eberhard [46] cite three cases of cancer of the antrum and stress the value of irradiation. Since the cases were fairly well advanced when first seen, it would appear that they considered them inoperable. They state that doses of from 5000 to 8000 r may be given over a rather short period. Because many of these cases are not diagnosed until late, the authors advise early biopsy in all suspected cases and recommend the use of a Vim-Silverman biopsy needle, with which a specimen may be easily obtained through an inferior meatus puncture.

NONMALIGNANT TUMORS

Schuknecht and Lindsay [47] classify cysts of the sinuses as follows:

A. Cysts arising from the sinus mucosa
   1. Nonsecreting cysts
   2. Secreting cysts
      (*a*) Retention (glandular) cyst
      (*b*) Mucocele

B. Odontogenic cysts
   1. Follicular cysts (dentigerous)
   2. Radicular (root) cyst

The pathogenesis is described, and typical histopathological sections are shown, together with roentgenograms, all of which give a clearcut picture of each type. The nonsecreting cysts are thought to arise in the submucosa from dilatation of the stroma by accumulation of fluid, which may be due either to allergy or to infection.

Retention cysts are due to blockage of the duct of the secreting gland. Mucocele is due to occlusion of the ostium of the sinus.

Follicular cysts develop from the enamel organ epithelium about the crown of the unerupted tooth. The radicular cyst, on the other hand, develops around the root of the tooth.

Montreuil [48] discusses the same entity, reporting two cases. He also cites numerous references in the literature and concludes that the evidence points to an embryologic origin, "either inclusion in the lateral facial cleft or prolongation of the lacrimal duct." It is to be noted that in both reports the preponderance of cases in women is commented on. The diagnosis is not difficult, since the mass is superficial, easily delineated and entirely within the soft tissues.

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45. Schmidt, M.: Cylindrom der Stirnhöhle, Kasuistischer Beitrag, Acta oto-laryng. **37**:426 (Oct.) 1949.

46. Smith, A. T., and Eberhard, T. P.: Malignant Lesions of Nasal Fossae and Sinuses: Diagnosis and Treatment, Pennsylvania M. J. **52**:932 (June) 1949.

47. Schuknecht, H. D., and Lindsay, J. R.: Benign Cysts of the Paranasal Sinuses, Arch. Otolaryng. **49**:609 (June) 1949.

48. Montreuil, F.: Cysts of the Nasal Vestibule, Ann. Otol., Rhin. & Laryng. **58**:212 (March) 1949.

Sage [49] describes radicular, follicular and median maxillary cysts and cites several cases. Therapy depends on size and location and may comprise either enucleation alone or with a nasocyst window or conversion into one cavity with the antrum.

Miller and Moore [50] discuss the embryology of nasoalveolar cysts and report three cases. Nasoalveolar cysts are of fissural origin, being derived from ectodermal rests. They are located external to the bone and not in the bone, and their lining membrane is typically columnar, with or without cilia. The location is usually in the external portion of the nasal vestibule, causing a bulge in the nasolabial fold often extending to the cheek and palpable in the gingival recess. The authors point out that these tumors are not to be confused with such lesions as the nasopalatine cyst, dental root cyst, cyst of the papilla palatina and incisor canal cysts whose origin is either from one of the original clefts or from a dental element.

Schlander's case [51] was unusual because of the fact that the bulb was displaced downward and medially by the mucocele, which originated in the temporal recess of the frontal sinus and broke through the thin orbital roof into the superoexternal angle. The bulb being compressed against the unyielding nasal wall suffered some distortion, which was noted by fine folds in the retina above the papilla seen on retinoscopy. This condition disappeared gradually after extirpation of the tumor, with no appreciable loss of vision.

Schlagenhauff [52] states that about 20 per cent of ethmoid mucoceles involve anteriorly lying cells in the lacrimal sac area. These cases seldom cause any displacement of the bulb and are likely to be mistaken for a dacryocystitis. Absence of secretion on irrigation of the sac should make the diagnosis clear. In the case reported by the author the tear sac had been removed some years previously. Fluctuating swelling in the lacrimal area varying in size from time to time was diagnosed as a mucocele, roentgenograms showing absorption of ethmoid septums and clouding of the frontal and maxillary sinuses. Two similar cases are cited from the literature. The author brings out the point that pressure of the mucocele on the sac may cause tearing, retention and, possibly, infection, which, in turn, may invade the mucocele. Consequently, as shown in the cases cited from the literature, it becomes necessary to extirpate the lacrimal sac together with the mucocele.

Vadala and Somers [53] discuss the incidence of osteoma of the frontal sinus, its diagnosis and therapy, with liberal quotations from the literature, and report four cases. They present a diagram showing various approaches for the surgical removal of the growth. Attention is directed to the difference of opinion regarding the nasofrontal duct, some advising that it be left alone and others advocating plugging it to prevent infection. Most surgeons leave an external drain in the dependent part

49. Sage, R. A.: Diagnosis and Treatment of Maxillary Cysts, Ann. Otol., Rhin. & Laryng. **58**:1068 (Dec.) 1949.

50. Miller, J. B., and Moore, P. M., Jr.: Nasoalveolar Cysts, Ann. Otol., Rhin. & Laryng. **58**:200 (March) 1949.

51. Schlander, E.: Atypisch lokalisierte Mucocele der Stirnhöhle mit seltenem Retinabefund, Wien. klin. Wchnschr. **42**:718 (Oct. 21) 1949.

52. Schlagenhauff, K.: Ueber die Mucocele des Siebbeins in der Tränensackgegend, Wien. klin. Wchnschr. **42**:716 (Oct. 21) 1949.

53. Vadala, A. J., and Somers, K.: Osteoma of the Frontal Sinus, Arch. Otolaryng. **50**:618 (Nov.) 1949.

of the sinus, regardless of the internal management. Antibiotics, both before and after operation, have proved very helpful. In one case removal of the osteoma elsewhere was followed by a pansinusitis necessitating a radical operation. The condition failed to heal, however, and when suppuration and other symptoms persisted the patient was operated on again, and it was found that a coiled tantalum wire mesh previously placed in the nasofrontal duct "had acted as a scaffold across the nasofrontal duct and its interstices were completely filled with granulation tissue." This wire was removed along with granulations and diseased tissue into the ethmoid labyrinth, and the cavity was drained by a no. 16 french catheter. The patient made an uneventful recovery.

Harkins [54] reports a very unusual type of growth in the ethmoid sinus, namely, a neurinoma. It occurred in a 23 year old man whose chief complaint was epistaxis and nasal obstruction. The tumor presented itself as a soft reddish mass, filling the left nasal fossa. Roentgen ray therapy was administered at first and was followed later by an extensive resection through an external incision. The tumor occupied most of the nasal fossa, being attached to the nasal bone, septum, inferior turbinate, the ascending process of the superior maxilla and lamina papyracea. It extended two thirds of the way back into the nasal fossa and as high as the cribriform plate. The middle turbinate and the ethmoid labyrinth were completely absorbed by the growth. The tumor was lobulated, firm and smooth and bled only moderately. Histological section (illustrated) showed typical neurinoma. The patient recovered and was reported well after 16 months.

Lehman's case [55] concerned a man of 67 whose complaint was nasal obstruction and discharge. Red polypoid masses were found covering the middle and inferior turbinate bodies on both sides. All the sinuses were cloudy. Biopsy revealed squamous papilloma. There was a history of a previous spontaneous discharge from the rupture of a mass in the midfrontal region. At that time (about ten years previously) the fistula was enlarged and polypoid masses were removed from the frontal sinuses.

The fistula was again explored and hyperplastic tissue removed. Laboratory reports called it epidermoid and fibrous polypi. On the right, homonymous hemianopsia developed, but it was, however, only temporary. During the next six months cautery excision was done five times, followed by numerous chemical cauterizations at two week intervals. At present, the patient is comfortable, wearing a colored prosthesis over the frontal defect. The author presents a photomicrograph showing the papillary structure of the tumor and the large frontal defect.

Cooke and Powers [56] report two cases of fibro-osseous growth of the maxilla in two soldiers aged 18 and 25. One growth was discovered after the extraction of the first right upper molar. The growth recurred after a primary Caldwell-Luc operation, and the secondary operation showed that it had extended so widely as to preclude the possibility of removing it completely. Later roentgenograms showed that the antrum had again filled up. No malignant changes were noted, and subsequent examinations indicated no further extension.

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54. Harkins, W. B.: Neurinoma of the Ethmoidal Sinuses, Ann. Otol., Rhin. & Laryng. **58**:498 (June) 1949.

55. Lehman, R. H.: Papillary Sinusitis, Ann. Otol., Rhin. & Laryng. **58**:507 (June) 1949.

56. Cooke, S. L., and Powers, W. H.: Monostatic Fibrous Dysplasia: Report of 2 Cases, Arch. Otolaryng. **50**:319 (Sept.) 1949.

The lesion in the second case was discovered after a history was obtained of nasal obstruction, yellowish discharge and pain in the cheek and alveolus. Roentgenograms showed a dense mass blocking the left nasal passage, the glabella and the entire frontal sinus area, extending into the ethmoid block. Biopsy showed cancellous bone with myelofibrosis.

The author finds that this condition is frequently confused with von Recklinghausen's disease and the Hand-Christian-Schiller syndrome. However, its origin is unknown, although various theories have been advanced, such as endocrine dysfunction, perverted bone-forming mesenchyma or a disseminated neurological disease. Also, it was thought that the condition resulted from an abnormal response to trauma. The pathological characteristics of the growth are the replacement of the normal bone by a fibrous mass containing trabeculae of poorly formed primitive bone. The monostatic form of the disease may be found on the surface of any bone, including the calvarium. Pain is not an early symptom, thereby accounting for the tumor being frequently unnoticed for a long time. The roentgenologic diagnosis may be difficult because it is not always possible to distinguish it from enchondroma, bone cyst, giant cell tumor, osteochondroma, chondroma, sarcoma and fibroma. Biopsy alone will show the true character of the growth. The prognosis is usually good, since the tumors rarely undergo malignant degeneration. Treatment is governed by the size and location of the growth. When the lesion causes incapacity by reason of size and location it should be removed and replaced with autogenous bone chips. This procedure would apply to tumors involving the extremities. Otherwise, they should be left alone except for biopsy.

Criscenti [57] recites the clinical histories in six cases of nasal polypi, five originating in the antrum and one in the sphenoid sinus, and gives the details of the histological changes. Several of the masses were found to be cystic, rupturing on removal, with discharge of a thin watery fluid. The condition in these cases would appear to be due to prolapse of the sinus mucosa with extension of the polypocystic mass through the ostium into the nasal cavity. The sections shown support this diagnosis, the outer coat of the tumor consisting of stratified epithelium resting on a thickened substratum containing only a few scattered glandular elements.

Criscenti asserts that the pathogenesis is easily demonstrated by approaching the mass via the canine fossa. The detached mucosa is located, and a probe passed into the cavity will extend toward the extruded portion as it passes through the ostium.

The findings do not support the theory of Hirsch and Forschner, which presupposes an inflammatory background as the prime etiological factor.

SURGICAL THERAPY

Wilkerson [58] presents arguments in favor of a large surgical opening into the antrum via the middle meatus for the treatment of subacute and chronic sinusitis.

57. Criscenti, G.: Nuove considerazioni sulla etiopatogenesi del prolasso della mucosa dei seni paranasali, Arch. ital. laring. **57**:141 (May-June) 1949.

58. Wilkerson, W. W., Jr.: Antral Window in the Middle Meatus: Experiments and Presentation of Cases in Which an Antral Window Was Made in the Middle Meatus of the Human Subject and No Additional Surgical Procedures Were Performed, Arch. Otolaryng. **49**:463 (May) 1949.

He refers to some of the older literature in which this procedure was advocated and then considers the arguments against traumatizing the region of the ostium. In addition, he summarizes the results of a questionnaire addressed to 491 otolaryngologists, 366 of whom replied. Of these, 236 had never performed the operation, while 94 had done it with results which were difficult to interpret. However, 40 others made it clear that they had made a window in the middle meatus either with or without the customary window in the inferior meatus during the course of a routine radical maxillary sinus operation, with 97 per cent of the patients receiving better than average results.

Of the author's 32 patients, only 13 returned for a final examination. The other 19 stated that they had had no symptoms "and felt too good to visit a physician." Of the 13 examined, 12 showed no infection of the upper respiratory tract. Subjectively, most of them were relieved of the preoperative complaints. Several roentgenograms are presented, showing decided change in the appearance of the sinus preoperatively and postoperatively.

Goodyear [59] directly contradicts Wilkerson, maintaining that the middle meatus in the region of the ostium is vital for the normal functioning of the ciliary blanket and insisting that surgical procedure in this region be limited. He supports his thesis by referring to the work of Proetz, Hilding and Tremble, demonstrating the action of the cilia in the region of the ostium and citing his own experiments with iodized oil in the antrum, showing that the flow is always toward the ostium irrespective of the position of the patient's head.

Goodyear makes a plea for the antrostomy operation via the inferior meatus, pointing out the technical details that will insure a large permanent opening. He asserts also that the success of the Caldwell-Luc operation depends not so much on the extent of the denudation of the mucosa as on the proper fashioning of the counteropening in the inferior meatus. Several illuminating illustrations accompany the article.

Bordley and Longmire [60] describe a radical procedure for dealing with cases of extensive intranasal lesions. Such cases include those with tumors requiring wide exposure for complete extirpation and control of bleeding, cases with previous operation in which landmarks have been obliterated and cases of progressive osteomyelitis. The operation is a combination of a lateral rhinotomy with reflection of the nasal organ on a hinge of skin and periosteum, thus exposing the entire interior of the nose. The septum is resected, thereby leaving a small strip of cartilage below for support. Access is thus afforded to all the sinuses. The article is beautifully illustrated, and several photographs showing excellent cosmetic results accompany the case histories presented.

Tschiassny,[61] in commenting on an article by Murray [62] on indications for and technic of alveolectomy, in which it was stated that the operation had been performed in "some 200 cases," casts some doubt on the suitability of cases for this procedure. For comparison, he lists the antrum operations performed at the Cincin-

59. Goodyear, H. M.: Intranasal Surgery of the Maxillary Sinus, Arch. Otolaryng. **50**:795 (Dec.) 1949.

60. Bordley, J. E., and Longmire, W. P.: Rhinotomy for Exploration of the Nasal Passages and the Accessory Nasal Sinuses, Ann. Otol., Rhin. & Laryng. **58**:1055 (Dec.) 1949.

61. Tschiassny, K.: Alveolectomy, Cincinnati J. Med. **30**:299 (June) 1949.

62. Murray, M.: Alveolectomy—Its Indications and Technique, Ohio State M. J. **44**:1220 (Dec.) 1948.

nati General Hospital in the 10 years from 1939 to 1948, during which time a total of 149 operations were performed, including both Caldwell-Luc and intranasal antrostomies. Since the advent of the antibiotics there has been a steady decline in the number, so that in 1947 there were only three Caldwell-Luc operations and one antrostomy. The figures for 1948 were six and two respectively.

Sibbold [63] states that the transantral exenteration of the ethmoid and sphenoid sinuses, popularized by Emiro de Lima, in South America, is not new, dating back as far as 1894 (Jansen). It is especially indicated in cases of associated chronic infection in the antrum, ethmoid and sphenoid sinuses. The anatomic landmarks are described with attention directed to the relatively greater width of the posterior ethmoids as compared to the anterior group, owing to the posterior obliquity of the lamina papyracea. It is for this reason that Tato has recommended entering the labyrinth through the posterior cells. The "inferior angle" formed by the union of the internal and inferior walls of the orbit is a very important landmark, which the author illustrates in one of his several excellent drawings. Although the technic of the operation has been described a number of times, the current article is well worth reading because of the illustrations.

Work's experience [64] in the use of tantalum plates for the correction of frontal defects due to trauma brings out some very valuable points, particularly in cases in which the sinuses were involved. Instances are cited in which subsequent to the implantation of a tantalum plate serious infection developed in the sinuses, often with extensive destruction of tissue, necessitating removal of the plate and further surgical procedure. As a result of experience in these cases, Work postulates certain definite rules. Complete ablation of the frontal and ethmoid sinuses should be done in every case in which an alloplastic material, such as tantalum, is to be used for cosmetic purposes. This ablation may be accomplished at the original débridement, even though there is no evidence of infection at the time. The use of antibiotics yields only a false sense of security, because it does not ensure against a late infection. Small sinuses can be successfully ablated from above via the coronal incision. However, if the sinuses are extensive they should be exenterated via a second incision with the Lynch or Sewell technic.

In any event, even after a successful ablation, at least six months must elapse before the alloplastic graft is inserted.

Proetz [65] advises avoiding trauma to the sphenoid ostium. He suggests opening the sinus through its anterior wall at the thinnest point with the Sluder sphenoid knife and enlarging the opening upward and downward with a small punch forceps. Larger openings tend to close anyway and are not required. Since secretions are normally propelled toward the natural ostium, normal function will return after the acute swelling has subsided and abnormal secretions are reduced.

Lierle and Huffman [66] used morcellated cancellous bone obtained from the crest of the ilium to fill a defect in the frontal bone, with excellent results. The bone

63. Sibbold, D. W.: Surgery of Pan-Sinusitis: Transantral Operation of Ermiro de Lima, South African M. J. **23**:468 (June 11) 1949.

64. Work, W. P.: Paranasal Sinuses in Relation to Skull Injury, J. A. M. A. **141**:977 (Dec. 3) 1949.

65. Proetz, A. W.: Operation on the Sphenoid, Tr. Am. Acad. Ophth. **53**:538 (May-June) 1949.

66. Lierle, D. M., and Huffman, W. C.: A Simplified Method of Obliterating Frontal Bone Defects, Laryngoscope **59**:61 (Jan.) 1949.

is obtained in the usual manner and cut into small pieces which are molded into the defect through a coronal incision above the hair line. The bone causes no irritation from pressure on the thickened dura and roentgenograms show that its vitality is maintained.

Hohlbrugger [67] reviews a series of 29 uncomplicated cases of frontoethmoid suppuration, some of them post-traumatic, in which operation was performed by a variety of external approaches. Most of the patients had previously undergone some intranasal surgery, and the indications for external operation were quite clear. In practically all the cases the lacrimal bone and frontal process were removed, all the mucosa of the frontal sinus stripped and the ethmoid cells exenterated. In some cases the author used a mucous membrane flap derived from the outer nasal wall to line the new nasofrontal passage. The cases are grouped according to type of pathologic condition and extent of the sinus, and the results are analyzed separately. In four cases the Jansen-Ritter technic was used with primary suture and intranasal drainage. In three cases healing was prompt and without recurrence. In one case a fistula developed at the internal angle. In a second group of seven cases with chronic frontal fistulas, mostly due to previous trauma and infection, the Jansen-Ritter or the Kuhnt technics were used with permanent recoveries, although the latter procedure involved destruction of the entire sinus with a cosmetic deformity. Partial open drainage and packing helped the obliteration.

In eight cases of suppuration due to foreign bodies there was recovery after extensive exenteration of the ethmoids and the sphenoid, with prolonged external drainage of the frontal sinus. There were six cases of suppuration with external fistulas due to incomplete intranasal operations and extension of the disease. Experience in these cases showed that it was difficult to obliterate the deep frontal sinuses unless the excision was radical and postoperative packing continued for a long time. Fortunately, in several of the cases there was healing without obliteration of the sinus following the Jansen-Ritter procedure.

The author stresses the importance of careful débridement in the traumatic cases and the value of sulfonamides and antibiotics in preoperative and postoperative care.

NONSURGICAL THERAPY

Furstenberg [68] presents an evaluation of antibiotics in otolaryngology in which the advantages and disadvantages of their use are pointed out. He agrees that penicillin yields gratifying results in acute infections when the offending bacteria are sensitive. However, he warns against its continued use over a period of time in the face of a failure in early response. Such a condition calls for a bacteriologic study in order to determine the nature of the organism. Furthermore, one can expect very little from the local application in the nose and throat, because of the rapidity with which the agent is eliminated and because the bacteria are too deeply embedded in the tissues to be reached by surface applications. He can find no

67. Hohlbrugger, H.: Zur operativen Behandlung von Stirhöhlen-Siebbein-Eiterungen unter besonderer Berücksichtigung traumatischer Folgezustände, Ztschr. Laryng., Rhin., Otol. **28**:440 (Sept.) 1949.

68. Furstenberg, A. C.: Antibiotics in the Treatment of Diseases of the Ear, Nose and Throat, Ann. Otol., Rhin. & Laryng. **58**:5 (March) 1949.

justification for the use of penicillin in chronic sinusitis. In bronchiectasis it has proved of some value, but only when instilled directly into the cavities in concentrated solution (50,000 units per cubic centimeter).

According to Davison,[69] his experiments have shown that since 1945 the bacterial flora of the nasal cavity has become more and more resistant to penicillin. This resistance is attributed to the widespread use of the antibiotic in inadequate doses. He calls attention again to Fleming's postulates that for penicillin to be effective it must be used only against bacteria that have been proved to be sensitive, that the dose must be large and that the drug must reach the infected area in sufficient concentration. Davison shows that in a large series of cultures from the nose it was found that a concentration of three units per cubic centimeter was required to inhibit the growth of 81 per cent of the organisms. It is therefore futile to speak of a blood cencentration of 0.3 per cubic centimeter as being adequate. He therefore gives 1.6 to 3.2 million units per 24 hours, combining it with 0.7 Gm. of dihydrostreptomycin every 12 hours for several days. This procedure has cleared up "some long standing chronic infections without operative treatment other than puncture and lavage."

Griesman [70] states that the plica vestibuli frequently bars the entrance of medicament to the middle meatus where it is most needed to reduce congestion about the sinus openings. To overcome this bar, he has constructed a tubular curved nozzle whose internal opening is cut on the bias to permit the longer side to pass the plica, thereby lifting it out of the way. The drug is then dropped into the nose from this container while the patient puts his head in a modified Parkinson position, enabling the fluid to reach the middle meatus. The illustrations help to clarify the procedure.

Fabricant [71] discusses the evil results of overmedicating the nasal cavities, citing various authors on the subject of lipid pneumonia, argyrosis and disturbance of the sympathetic-parasympathetic balance, which results in vasodilatation. He makes a plea for controlled medication, the dose being regulated by properly gaged medicine droppers. The ideal sympathomimetic amine that is abuse-proof has thus far not been developed.

Everett [72] believes that failure following the use of sulfonamides and penicillin in the treatment of maxillary sinusitis is due to the lack of a vasoconstrictor, which is necessary to decongest the sinus mucosa. A study of 171 cases in which a combination of the two was used showed a higher rate of cure than when either was used. The good results are attributed to the shrinking effect of the vasoconstrictor, which reduces the edema of the mucosa, thus exposing a greater area to the bacteriostatic effect of the antibiotic.

Good results followed the instillation of sulmefrin® (sodium sulfathiazole sesquihydrate plus *dl*-desoxyephedrine) or desoxyephedrine (methamphetamine) or tersavin® (a combination of penicillin and ephedrine). These drugs successfully

69. Davison, F. W.: Antibiotics and Sinus Infections, Laryngoscope **60**:131 (Feb.) 1950.

70. Griesman, B. L.: Improved Method of Applying a Medicinal Solution to the Middle Meatus of the Nasal Chamber, Arch. Otolaryng. **50**:224 (Aug.) 1949.

71. Fabricant, N. D.: The Overmedicated Nasal Cavity, Am. J. M. Sc. **217**:462 (April) 1949.

72. Everett, A. R.: The Importance of Vasoconstriction in the Treatment of Acute and Chronic Maxillary Sinusitis, New York State J. Med. **49**:417 (Feb. 15) 1949.

controlled infections due to a variety of organisms. The only conditions that failed to yield were those due to H. influenza and the colon group. In these cases streptomycin was employed parenterally and locally with favorable results.

Stovin [73] reports favorable results from the use of bacitracin in 50 cases of sinusitis. It appeared to be influential in cases in which the sinusitis was resistant to penicillin and in which mixed infections were present. The best results were obtained in antral cases in which the drug was instilled into the sinus after irrigation. A solution was used containing 1,000 units of bacitracin to the cubic centimeter of a buffer diluent containing 0.5 methamphetamine hydrochloride U. S. P. in Ringer's solution. The solution is isotonic with a p_H of 6.5 to 6.7. This author, like Everett, found the combination with a vasoconstrictor to be a distinct advantage.

Gording [74] used a concentration of penicillin, 1,000 to 2,000 units per cc., in the treatment of 60 cases of acute and subacute maxillary sinusitis, with only moderately conclusive results. The cases were carefully investigated, with regard to symptomatology, findings and bacterial flora, and they yielded much interesting information. Of especial interest were the three cases of bilateral sinusitis with identical bacterial strains, in which one side was treated with the penicillin solution and the other with a boric acid solution. In two of the cases the duration of the infection was the same on the two sides (two to three weeks). In the third case, in which the condition had existed for six weeks, penicillin was instilled once or twice daily for more than a week and then supplanted with boric acid solutions. The boric acid solutions had to be used for seven weeks before the sinus cleared up. The other sinus, which had been affected for only two weeks, cleared up with boric acid irrigations in a much shorter time. This result would seem to prove that in acute cases there is a tendency to recover, irrespective of the medicament used, whereas in cases of longer duration the condition is not likely to yield to penicillin locally any more readily than to simple boric acid solution. Gording, however, is not willing to admit that penicillin has no value in these cases, for he states that heavy doses parenterally as well as locally may be very effective. The antrum mucosa is thin and sparsely supplied with blood vessels, and this condition makes absorption slow, certainly slower than that from the mucosa of the nasal chambers. But because the rapid expulsion of the fluid further diminishes the effectiveness of the drug larger doses and more frequent applications are required.

Vallancien [75] reports good results from aerosol penicillin in all his cases of acute infection of the maxillary and frontal sinus. Of 68 cases of chronic infection of the maxillary sinus, treatment resulted in failure in only 13, and in 30 cases in which the frontal sinus was also involved, four of 17 treated patients failed to respond. Failure of treatment is ascribed to allergy or to mechanical barriers, such as polypi and heavy secretion. Also, in some cases, the bacteria are penicillin resistant. It is important in these cases that adequate shrinkage of the tissues be provided to facilitate the penetration of the mist.

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73. Stovin, J. S.: The Use of Bacitracin in the Treatment of Sinusitis and Related Upper Respiratory Infections, New York Physician **32**:14 (July) 1949.

74. Gording, R.: Penicillin Treatment of Acute and Subacute Maxillary Sinusitis, Acta oto-laryng. **37**:12 (Feb.) 1949.

75. Vallancien: Le traitement des sinusites par les aérosols de pénicilline, Oto-rhino-laryng. internat. **33**:65 (April) 1949.

Maduro and Ludmer [76] sate that penicillin aerosol is a valuable adjunct in the treatment of acute, subacute and some cases of chronic rhinitis and sinusitis. They state that the apparatus designed by Maduro is an improvement over the one used by Barach. They also dispute Barach's claim that he brings about cure in all cases of acute sinusitis and in practically all the cases of chronic sinusitis, exceptions being rare. In their experience treatment with penicillin aerosol seldom results in cure in the chronic case. In simple acute rhinitis they advise the inhalation of penicillin aerosol (200,000 units in 3 to 5 cc. of fluid) at the rate of 8 to 10 liters of oxygen per minute administered twice daily. In acute antral infections the sinus should be irrigated and this procedure followed by the instillation of 100,000 to 200,000 units of penicillin in solution or tyrothricine or a sulfonamide. However, resolution will occur much more promptly if penicillin aerosol is used in conjunction with these drugs, so that seldom is it necessary to puncture and irrigate more than twice. In this connection they point out the superiority of Maduro's apparatus, which produces a negative pressure of 20 mm. mercury, although in most cases 10 to 12 mm. pressure is sufficient to effect a thorough displacement technic.

David [77] describes the various types of apparatus employed in the production of penicillin and streptomycin in vapor for the treatment of various diseases of the respiratory tract. He states that excellent results were achieved in infections of the nasopharynx, laryngitis and cough following acute conditions that often fail to respond to internal medication, steam inhalations, gargles, etc. In some instances the addition of streptomycin to the penicillin mixture has proved very effective. Patients are cautioned against smoking while under treatment because it can easily undo the beneficial effects of the drugs. Inhalation of 150,000 units of penicillin was practiced once or twice a day, proving successful in clearing up most of the acute and subacute conditions within six days or less.

Griesman [78] employed an aqueous solution of benzalkonium chloride (1:3500) and allantoin, both plain and with methamphetamine hydrochloride (1 per cent) for treatment in 54 unselected cases of acute and chronic infections of the upper respiratory tract. Twenty-eight patients received this treatment exclusively, while 26 had other additional therapy. The treatment lasted from one to 70 days. He reports good results in most cases: pain, headache and stuffiness were relieved, discharge was lessened and postnasal drip decreased. There was no evidence of irritation to the membranes except in three patients who complained of a burning sensation, nor were any constitutional reactions noted. The author asserts that the test solution in plain form should prove helpful for patients for whom ephedrine and other vasoconstrictors are contraindicated because of a hypertensive condition, sclerosis, pregnancy and vasomotor rhinitis. He also mentions that penicillin was added in some cases, as were other medicaments indicated by the symptoms.

Hynes [79] believes that penicillin aerosol can accomplish a great deal in the treatment of chronic sinusitis. He used the Barach apparatus, giving 40,000 units in

76. Maduro, R., and Ludmer: Les aérosols en oto-rhyno-laryngologie, Ann. d'oto-laryng. **66**:226 (April-May) 1949.

77. David, D.: Inhalation of Penicillin and Streptomycin in Office Practice, Arch. Otolaryng. **50**:156 (Aug.) 1949.

78. Griesman, B. L.: Study on the Range of Usefulness of a New Dual Form Intranasal Medicament, Arch. Otolaryng. **50**:190 (Aug.) 1949.

79. Hynes, F. J.: Penicillin Aerosol Therapy in Sinusitis, Ann. Otol., Rhin. & Laryng. **58**:189 (March) 1949.

one treatment per day. In his series of 212 patients, 58 were clinically cured; 34 had decided improvement; 45, moderate improvement, and 34, no improvement. Of the 58 with clinical cure, the condition in 15 was slight, in 17, moderate and in six, severe. It should be noted that in many of the cases Hynes also employed suction irrigation. Oxygen was also used in connection with the aerosol and is credited with having some beneficial effect. The author finds the treatment especially effective in children.

The number of treatments used in the cases cited ran from a minimum of five to a maximum of 38.

Berdal and Urdal [80] treated 30 patients with acute sinusitis and 15 with chronic sinusitis by the instillation of penicillin, 50,000 units per cc., every three days and found by comparison with a similar group treated in the conventional manner that the infection cleared up much sooner and fewer patients needed operation. Careful investigation of the bacterial flora demonstrated many cases in which the germs were not penicillin sensitive, and this lack of sensitivity may account for the indifferent results reported elsewhere. Examination of the fluids washed from the sinus several days after instillation showed a remarkable persistence of the penicillin, even up to 15 days.

McPhail,[81] in experiments on rats under proper controls, demonstrated the fact that a 0.1 per cent solution of naphazoline hydrochloride (privine®) was more stimulating to the nervous system than any of five other vasoconstrictors used. These vasoconstrictors included aqueous ephedrine, 0.5 per cent; ephedrine in oil, 0.3 per cent; phenylephrine and triamine. The solutions were introduced both intranasally and intraperitoneally, and the central stimulation was recorded on kymographs, similar to the tests previously conducted by Schulte and co-workers.

Kolmer and Rule [82] and Kolmer, Bondi, Schillinger and Rule [83] investigated the immunologic properties of a stock polyvalent bacterial vaccine against the secondary bacterial invaders of the common cold. Following the oral and intra-abdominal administration of these vaccines in a number of mice with a corresponding number of control animals receiving placebos, it was found that active immunity against hemolytic streptococci, types I, II and III pneumococci, Klebsiella pneumoniae (type A) and Staph. aureus was produced by the vaccines in a "significant number of mice" by both routes of administration, whereas the placebos similarly given failed to elicit any immunity.

80. Berdal, P., and Urdal, K.: Local Treatment with Penicillin in Sinusitis: Determination of Penicillin Content in Maxillary Sinus Secretions for 15 Days After Application of Penicillin, Acta oto-laryng. **37**:161 (April) 1949.

81. McPhail, M. K.: The Central Stimulant Action of Some Commercial Nose Drop Preparations, Laryngoscope **59**:278 (March) 1949.

82. Kolmer, J. A., and Rule, A. M.: Active Immunization Against Secondary Bacterial Infections of the Common Cold: I. Acquired Immunity in Mice Following Oral and Intra-Abdominal Administration of Stock Polyvalent Bacterial Vaccines, Arch. Otolaryng. **50**:687 (Dec.) 1949.

83. Kolmer, J. A.; Bondi, A., Jr.; Schillinger, C., and Rule, A. M.: Active Immunization Against Secondary Bacterial Infection of the Common Cold: II. Production of Protective Antibodies in Human Adults by the Oral Administration of Stock Polyvalent Bacterial Vaccines, Arch. Otolaryng. **50**:693 (Dec.) 1949.

Similar experiments with 116 adults given the same vaccine orally (Oravax) and 35 controls receiving placebo tablets yielded similar results. Protective antibodies against hemolytic streptococci were found in 19.8 per cent, against type I pneumococci in 25 per cent and against K. pneumoniae in 19.8 per cent of the 116 adults "when the serums were tested against two minimum lethal doses of the respective organisms."

The authors conclude that the vaccine is successful in an appreciable percentage of adults. The tablets were given according to varying dosage scales, ranging from one tablet a day for seven successive days followed by two tablets a week for a total of 50 tablets up to 100 tablets over 60 days. Six different dose arrangements are listed, but no clue is given as to which particular arrangement yielded the best results.

Baird [84] adheres to the concept of allergy as stated by von Pirquet, whom he quotes as saying that "immunization and hypersensitivity therefore can be connected most intimately with one another. For this general concept of the changed capacity to react, I suggest the term allergy." According to this author, it is wrong to separate sensitivity from immunity. In his experience many patients who reacted to dust were greatly benefited by injections of a bacterial vaccine. He believes that bacteria are abundant in ordinary house dust. The preparation used by the author is Sharp & Dohme's H. Influenzae Serobacterin, which is given subcutaneously at three to five day intervals in ascending doses from 0.2 to 2.5 cc. Several illustrative cases are cited.

Blassingame [85] describes the cannulization of the maxillary sinus via the natural ostium for irrigating the sinus, pointing out some of the technical details involved in locating the opening. In answer to the question "How do you know when the cannula is in the proper position for effective irrigation?" he offers the following criteria: 1. The irrigating fluid returns freely within a short time after introduction. 2. A peculiar sound, which he terms the "antrum growl" is heard, owing to vibration of the membranous wall as the fluid and air return. 3. There is prompt emptying of the sinus contents. 4. The cannula can readily be rolled in the fingers, thereby indicating that the point is in the antrum. 5. Pain is felt in the teeth as the fluid enters the sinus.

If the ostium is blocked by edema, the author advises a trephine opening in the inferior meatus beneath the attachment of the inferior turbinate, using a Thornwald trephine instrument, which cuts a hole sufficiently large to permit the passage of a cannula and free egress of the irrigating fluid.

The third procedure described is the intranasal antrostomy in which the trephine opening just described is enlarged with a rasp and the Yankauer antrum forceps.

Baulande [86] states that he gets good results from short wave therapy in both acute and chronic sinusitis and gives the details of technic in its application. He credits short wave with antibacterial powers through the increase in temperature as

84. Baird, K. A.: Sinusitis, Allergy and Bacterial Vaccine, Ann. Allergy **7**:339 (May-June) 1949.

85. Blassingame, C. D.: Technical Procedures in the Management of Diseases Involving the Sinuses, J. Oklahoma M. A. **42**:376 (Sept.) 1949.

86. Baulande, M.: Thérapeutique physiothérapeutique des sinusites et des phénomènes infecticeux rhino-pharyngés, Paris méd. **39**:441 (Sept. 24) 1949.

well as antitoxic and antibiotic properties. In addition, resolution is hastened through increase in the circulation and stimulation of phagocytosis.

The article is brief, and no statistics are presented.

CLINICAL AND GENERAL THERAPY

Van Alyea [87] points out some of the important changes that have taken place in otolaryngology in recent years. He also calls attention to some of the dangers attending indiscriminate medication, such as toxemias and various anemias from the sulfonamides and reactions due to excessive use of nose drops.

With regard to chronic sinusitis, the author again emphasizes the value of conservative therapy aimed at improving the general defenses, such as the mucociliary mechanism and the removal of obstacles to drainage. Attention to the individual case will very frequently restore normal function and obviate the necessity for operation.

Hollender [88] answers a number of questions relative to sinusitis for the benefit of general practitioners: How does nasal sinusitis develop? How does the disease manifest itself? Is sinusitis capable of acting as a focus of infection? What is the relationship of allergy to nasal sinus disease? What is the status of nasal medication? What complications may result from nasal sinusitis? What modern methods are employed in the diagnosis of sinusitis? Is nasal sinusitis a curable disease?

These questions are all discussed in the light of modern advances, and the conclusions coincide with the present day conservative attitude.

MAXILLARY AND SPHENOID SINUSES

Ballantyne and Rowe,[89] in a study of 206 consecutive cases of chronic maxillary sinusitis, gathered some interesting information. They found that roentgenograms were far more reliable in diagnosis than transillumination. Eosinophils were found less frequently in the secretions than in the biopsy specimens of mucosa. Pus cells were almost constantly found in cases with secretion. However, they could be recovered in two fifths of the cases in which only a hypertrophied mucosa was shown without secretion. Sixty-six patients were selected for study of the effects of local penicillin therapy, half of the group receiving the treatment, the other half being treated without penicillin. Twenty thousand units of penicillin calcium in 2 cc. of isotonic sodium chloride solution were added to a mixed sulfonamide cream in a lanette wax base. Ten cubic centimeters of this mixture placed in a Watson-Williams syringe was injected into the antrum after irrigation and the sinus filled. The condition in three fourths of this group cleared after three injections or less, as against clearance in only two thirds of the patients conventionally treated. The condition in 80 per cent of those with penicillin-sensitive organisms cleared, as compared with that in 60 per cent of patients with penicillin-resistant germs.

The most interesting feature of this study is the fact that the late results did not substantiate early conclusions as to cure. Absence of symptoms and completely

87. Van Alyea, O. E.: Otolaryngology for the General Practitioner, Nebraska M. J. **34**:166 (May) 1949.

88. Hollender, A. L.: Nasal Sinusitis: Clarification of Certain Problems of General Interest, J. Florida M. A. **35**:691 (May) 1949.

89. Ballantyne, J. C., and Rowe, A. R.: Some Points in the Pathology, Diagnosis and Treatment of Chronic Maxillary Sinusitis, J. Laryng. & Otol. **63**:337 (June) 1949.

cleared sinuses on roentgenograms after three months were found in not more than one fourth of the treated patients, compared with that in only one fifth of the controls. It would appear, therefore, that irreversible changes in the mucosa of the sinus are far more frequent than generally believed.

Koumrouyan [90] stresses the importance of diagnosing chronic latent sinusitis because of its frequent association with bronchopulmonary pathological conditions. In most cases the symptoms of sinusitis are minimal in comparison with those arising from the complicating condition. Careful and repeated examination will sooner or later establish the diagnosis. Among the signs that should excite suspicion of sinusitis are the following: hypertrophy of the middle turbinate body not due to septum deviation; tiny polypi in the region of the anterior ethmoid cells; a streak of mucopus in the middle meatus or the choanae, hyperplasia of the posterior tips of the inferior turbinates with violaceous coloring due to venous stasis, and a chronic pharyngitis not explained by other causes. In addition, one may find some clouding of the sinuses on roentgenograms which should indicate a diagnostic puncture and the instillation of a contrast medium.

The author points out the differential points between essential or idiopathic asthma and bronchial asthma due to nasopharyngeal infection, the former condition being associated with typical allergic phenomena, with typical pallor of the nasal mucosa, obstruction, polypi, etc., whereas in the latter, one will find the signs mentioned above which can lead to the focus in one or more of the sinuses. Several typical cases are related, including cases of asthmatic bronchitis, bronchiectasis with hemoptysis, one that was ushered in by an acute gastric episode simulating appendicitis, one case of bronchopneumonia and a case in which paresthesias and peripheral polyneuritis were traced to a chronic maxillary infection of long standing.

While the author would decry being classed as a "sinusophile," he is equally averse to an attitude which would label one a "sinusophobe." Experience has shown that extremists have been responsible for the slaughter of tonsils and teeth in the name of focal infection. Yet, he is convinced that too often an insidious asymptomatic sinus infection has been overlooked because of inadequate examination. Carefully repeated and detailed examination will uncover many a focus responsible for a more serious ailment at some remote point. The cases he presents would seem to bear him out.

Zinner [91] states that in order to avoid all the dangers of antrum puncture via the inferior meatus it is safer to penetrate the anterior wall through the canine fossa via a small incision through mucosa and periosteum, making the opening in the bone with a small dental burr. The needle or cannula then is inserted, the sinus irrigated and the opening, which should be about 4 mm. in diameter, kept patent for a few days with a small strip of iodoform gauze. Subsequent irrigations can be readily performed through this opening even if it appears to be closed, since the opening is filled with a thin layer of fibrous tissue through which the needle can pass without any pressure. He claims this procedure is not only safer but less painful than the intranasal puncture.

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90. Koumrouyan, H.: Quelques aspects des complications des sinusites latentes chroniques, Schweiz. med. Wchnschr. **79**:489 (June 4) 1949.

91. Zinner, H.: Neue Erfahrungen in der Antrumtherapie, Ztschr. f. Stomatol. **46**:156 (April) 1949.

Eadie [92] states that sphenoid infection may be a part of a general inflammatory process affecting all the nasal mucosa or it may be an isolated process. In the former case spontaneous recovery may take place unless anatomic factors interfering with drainage and ventilation predispose to retention. Eadie mentions high septum deviation, polypi, turbinal hypertrophy and chronic hyperplasia of tissues in the recess. Another etiologic factor is the soot and dust laden atmosphere in many urban centers.

The symptomatology of acute and chronic sphenoiditis is listed and the therapy indicated. In acute cases he advises upright position, shrinking agents, vapor inhalations and anodynes. Sulfonamides have been found to be of some value. Roentgen rays and diathermy, on the other hand, may aggravate the symptoms. Patients with a chronic condition are treated with a view to facilitating better ventilation and drainage. Resection of the septum, removal of polypi, reduction of the turbinate bodies and sinus lavage all contribute to a better functioning sinus. Since many of these cases are associated with infections of the ethmoids and antrums, it is important that the over-all therapy, whether palliative or surgical, be planned so as to correct all the conditions at the same time. An undrained focus in one area may be the cause of persisting and recurring infection in the associated sinuses.

Dunlop [93] suggests the following measures for the treatment of sinusitis associated with allergy: (1) treat the allergic condition; (2) establish sinus drainage; (3) relieve pain; (4) use aids to the restoration of the mucous membrane, and (5) use other measures if drainage alone fails to cure the infection. He also recommends that attention be given to the patient's general health—the administration of calcium and parathyroid preparations to reduce tissue permeability; of dilute nitrohydrochloric acid, to reduce the alkali reserve, and of ephedrine and phenobarbital and atropine, to diminish secretion and autogenous vaccines.

With reference to operation, he states that it is useless to drain sinuses in the presence of septic foci in the teeth, tonsils or adenoids, since these foci may be supplying the allergen responsible for the condition. These foci should be removed first. No surgical procedure should be undertaken during an acute allergic attack. A deviated septum should always be straightened when the time is opportune. Dunlap no longer performs intranasal antrostomies. If the sinusitis fails to clear under palliative treatment and the evidence indicates a thickened membrane, it should be removed via a Caldwell-Luc operation.

Schenck [94] describes the changes that take place in the ethmoid cells in persons sensitive to various allergens. Since the turbinals act as the primary shock organs, the early response to the allergen will be manifested here at first but may later extend to the maxillary, ethmoid, frontal and sphenoid sinuses, in that order of frequency. The early edema, eosinophilic infiltration, thickening and hyperplasia, the result of changes in the blood vessels, will sooner or later become irreversible unless the cause is discovered and eliminated. Secondary bacterial invasion frequently follows because of the lowered resistance, and the combination is then more difficult

92. Eadie, C. M.: Sphenoidal Sinusitis in Adults, M. J. Australia **36**:11 (July 2) 1949.

93. Dunlop, E. C.: Modern Treatment of Sinusitis Associated with Allergy, M. Press **111**:433 (Nov. 9) 1949.

94. Schenck, H. P.: Effects of Allergy on the Ethmoid Sinuses, Arch. Otolaryng. **49**:48 (Jan.) 1949.

to evaluate. Roentgenographic evidence of cloudiness when secretion is minimal would point to allergy.

Treatment is important, not only to prevent progressive changes but to avoid involvement of the lower respiratory tract. Operation is indicated only after skin tests and desensitization have failed.

Fox and Livingston [95] believe that the cold-susceptible person is so predisposed because of an allergy to the virus or its proteins. In the majority of cases these patients have the subclinical rather than the frank type of allergy. The authors reviewed the literature on the subject of susceptibility to colds induced by exposure, chilling, fatigue and debility and found that laboratory data to support this theory are thus far meager and unconvincing. However, the fact that these factors are known to influence the allergic patient would seem to support their belief that the inherent allergy is the real predisposing factor. Analysis of the case histories of more than 3,000 patients, clinic as well as private, showed that well over 60 per cent gave a history of clinical or subclinical allergy and that all of them displayed some degree of hyperplasia of the mucosa of the upper respiratory tract.

Grove [96] believes that the importance of sinus infection in allergy has frequently been overlooked. Careful study of a series of 200 asthmatic patients followed for periods of from six months to 17 years after operation indicated that about 70 per cent showed permanent improvement. The degree of improvement was in direct proportion to the thoroughness of the operation. Tissues proved to be diseased must be removed completely via radical surgery. Naturally, operation is not indicated unless the diagnosis is thorough and complete. Detailed roentgenographic studies with contrast media as well as bacteriologic studies are imperative. The author has found that a 25 per cent solution of thorium dioxide is very satisfactory and less irritating to the patient than the iodine solutions. Simultaneously, the allergy must be treated either by elimination of offending allergens or by desensitization. Grove found that his best results were obtained in combined types of asthma in which both infection and allergy were present. Also, patients whose asthma was of less than five years' duration and who were between the ages of 31 and 50 had the best chance of recovering.

Glover,[97] in discussing the association of allergy with sinus disease, emphasizes the importance of thorough examination of the nasopharynx with the nasopharyngoscope, since disease or infection here may be the cause of prolonged nasal symptoms as well as infections of the lower respiratory tract. Also, in these patients one is likely to find a definite sensitivity to bacterial invaders, which can be demonstrated by skin tests. The therapy suggested is along familiar lines.

PAIN AND HEADACHE

Burnham [98] describes a typical case of anterior ethmoidal nerve neuralgia in a woman of 31, which was relieved by section of the nerve. The pain was experienced in the frontal, parietal, occipital and vertex areas, accompanied with stiffness of the

95. Fox, N., and Livingston, G.: Role of Allergy in the Epidemiology of the Common Cold, Arch. Otolaryng. **49**:575 (June) 1949.

96. Grove, R. C.: The Importance of Sinusitis in Allergic Manifestations, Laryngoscope **59**:653 (June) 1949.

97. Glover, C. H.: Management of Allergic Sinusitis, South. M. J. **42**:613 (July) 1949.

98. Burnham, H. H.: The Anterior Ethmoid Nerve Syndrome, Arch. Otolaryng. **50**:640 (Nov.) 1949.

muscles of the jaw and cheek, which would persist for days at a time. It ranged in severity from an ache to a throbbing and sharp, stabbing pain. Since the pain was bilateral, both nerves were severed at the ethmoidal foramen on the orbital side.

The author discusses the theories advanced to explain this entity, attributing it, in the main, to irritation of the nerve and its branches, either at the foramen or within the middle turbinate, presumably from products of bacterial invasion within the mucosa. The wide distribution of the pain is explained as being due to interference with normal conduction for a distance of several centimeters beyond the point of irritation as well as to stimulation of the sympathetic fibers which accompany the nerve.

Dalsgaard [99] examined 171 patients, some without history of headache and others comprising a group with migraine, vasomotor headache, psychogenic headache and myogenic headache, employing the histamine and glyceryl trinitrate tests with the idea of reproducing the typical headache. Histamine chloride, 0.25 mg., was injected subcutaneously, and glyceryl trinitrate, 6 mg. in a 2 per cent ointment, was applied by means of a spatula in the frontotemporal region. It was found that migraine and vasomotor headaches could be reproduced in almost 100 per cent of the typical cases as far as quality was concerned. The localization, however, was less constant, and the glyceryl trinitrate test was more reliable than the histamine. The other types of headaches could not be reproduced, and this lack was particularly noticeable in the psychogenic types. Electroencephalography before, during and after the tests showed no dysrhythmia.

Treatment with histamine or antihistamines was not particularly successful in the group in which headache was reproduced by the histamine test.

One of the cases reported by Adams-Ray [100] concerned a 75 year old man with a history of a gnawing, constant pain in the upper jaw of about eight months' duration. It had been increasing to the point of intolerance, greatly disturbing the patient's sleep. Roentgenograms failed to reveal any bony changes, and extraction of a molar tooth was without avail. However, the antrum was opened because roentgenograms showed some cloudiness, and an abscess as large as a walnut was found in the mucosa at the bottom of the sinus. There was no demonstrable communication with the alveolus. Recovery was prompt, with complete relief from pain.

TRAUMA

Radcliffe [101] reports four cases of fractures involving the sinuses and calls attention to certain important aspects of the therapy. In the cases in which the antrum and the orbital floor were involved, the sinus was opened via a Caldwell-Luc operation, displaced bony fragments were replaced, and the sinus was drained. When the frontal sinus is involved it is necessary to expose the posterior wall, and if this structure is found to be involved sufficient bone should be removed to permit inspection of the dura for possible lacerations.

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99. Dalsgaard, N. T.: Results of Some Diagnostic Tests in Different Forms of Headache, Acta psychiat. et neurol. **24**:391, 1949.

100. Adams-Ray, J.: Comments on the Diagnosis of Chronic Painful Conditions with a Report of 2 Cases of Obscure Pain, Acta psychiat. et neurol. **24**:281, 1949.

101. Radcliffe, A.: Fractures Involving Air Sinuses, J. Laryng. & Otol. **63**:453 (Aug.) 1949.

Radcliffe cautions against irrigating the antrum in these cases because the pressure of the fluid might carry infected material through the fractured orbital floor into the orbit.

Schönfelder [102] relates a case of a foreign body penetrating the cheek through the antrum into the orbit, causing displacement of the bulb upward and outward. A boy of 11, while at play, about three weeks previous to examination was thrown into a hedge. He was treated conservatively at first, but when a fistula below the lid failed to heal and the bulb did not recede, he was brought to the rhinologist. Aside from the displacement of the bulb there were no orbital findings, and the roentgenograms showed no indication of bony involvement. The antrum, however, was very dark. A Caldwell-Luc procedure was performed, and eight splinters of wood were removed, averaging 10 to 20 mm. in length and about 10 mm. in thickness. The floor of the orbit had been penetrated. After operation, the bulb receded promptly and the fistula healed.

MISCELLANEOUS

Burrows [103] reports six cases of extensive eczema of long standing which cleared up after removal of foci of dead bone along the alveolar ridge and maxillary sinus. In all these cases the affected teeth had been removed, and in several of them a Caldwell-Luc procedure had been performed. A cure, however, was not attained until the diseased bone along the alveolar ridge was completely removed.

Lewy and Manning [104] report a case of actinomycosis in a 58 year old man, in which the diagnosis was not certain until the patient was operated on. The condition apparently began with an attack of "flu," although there was a history of a tooth extraction a few days previously. Pain, swelling, chills and fever followed. The swelling extended to the lids, scalp, face and neck. The appearance was that of a cellulitis, and treatment was palliative until abscesses developed in several locations, which were incised and drained. Roentgenograms showed a cloudy antrum and ethmoid, with some evidence of involvement of the bone. A Caldwell-Luc operation and transantral ethmoidectomy disclosed an osteomyelitis of the maxilla with sequestration. Despite irrigations and other procedures, the fistulas continued to drain, and the process was not influenced by penicillin and sulfadiazine. Cultures produced hemolytic and nonhemolytic Staph. albus. Later, hemolytic Staph. aureus was recovered. This growth was in the early stages; later an anaerobic culture showed diphtheroids and still later Actinomyces bovis. Irrigations with 10 per cent thymol were added to the antibiotic therapy and brought about subsidence of the infection about four months after the onset.

Hitschler [105] conducted a survey among 900 college graduates, half of whom were swimmers, in an attempt to evaluate the relationship of swimming and diving to sinusitis and hearing loss. He found that the incidence of these complications

102. Schönfelder, R.: Ein seltener Fall von Verletzung der linken Oberkieferhöhle und Augenhöhle, Klin. Monatsbl. Augenh. **114**:542, 1949.

103. Burrows, M. T.: Eczema: A Symptom of Specific Changes in Rotting Tissue Elsewhere in the Organism, Urol. & Cutan. Rev. **53**:478 (Aug.) 1949.

104. Lewy, R. B., and Manning, E. L.: Actinomycosis Involving Ethmoid and Maxillary Sinuses, Arch. Otolaryng. **49**:423 (April) 1949.

105. Hitschler, W. J.: The Relationship of Swimming and Diving to Sinusitis and Hearing Loss, Laryngoscope **59**:799 (July) 1949.

was no greater among adult trained swimmers than among unselected college graduates. However, it is interesting to note that the responses from otolaryngologists and pediatricians indicated a higher incidence than that reported by coaches and swimming experts. Factors leading to infection are listed as lack of proper training supervision, immaturity, the presence of already existing infection of the upper respiratory tract and contaminated water. Swimming in salt water was considered safer than in fresh water.

Barton [106] offers some observations in the management of oroantral fistulas based on an experience with 41 cases, 12 of which were recent and 29 chronic. In the recent cases treatment was made by irrigation via the inferior meatus, followed by instillation of 5 cc. of penicillin (5,000 units per cubic centimeter). The fistula is not disturbed, and the patient is cautioned not to blow the nose. The fistula was closed by biting away a portion of the alveolus and approximating palatal and buccal mucoperiosteal flaps with mattress sutures. At times, a temporary saddle plate of dental compound was fitted over the sutured area to protect it from oral secretions and food. If a portion of tooth or foreign body is present in the antrum it is removed via the Caldwell-Luc procedure.

If the fistula has been present for some time, the author advises cleaning out the diseased antrum by a Caldwell-Luc operation and closing the alveolar defect by any of the approved plastic procedures.

Bryant [107] found many cases of postnasal discharge to be due to hypertrophy of the posterior ends of the inferior turbinates. Rather than being the result of discharge from chronically inflamed sinuses, the condition may actually predispose to the latter by interfering with proper ventilation and drainage from the sinuses. Bryant has had good results with the application of phenol to the hyperplastic tissue after proper cocainization. The process may be repeated at weekly intervals until the mass is reduced. Histological studies of biopsy specimens taken at various intervals after the treatments show changes taking place that lead to reduction of the edema, the vascular spaces and other elements in the tissues without loss of surface epithelium and secreting cells.

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106. Barton, R. T.: Modern Management of Oroantral Fistula, Arch. Otolaryng. **50**:732 (Dec.) 1949.

107. Bryant, B. L.: Postnasal Discharge, Laryngoscope **59**:397 (April) 1949.

Abstracts from Current Literature

Ear

DEAFNESS DUE TO CHRONIC OTORRHOEA: ALLEVIATED BY TYMPANIC INSERT. N. ASHERSON, J. Laryng. & Otol. **64**:239 (May) 1950.

Asherson presents an interesting and practical article on the use of a cotton wool insert as a prosthesis for improvement of hearing in certain types of conduction deafness. He recommends its use in patients who have had bilateral radical mastoidectomies or bilateral permanent central perforations. The hearing loss should be between 30 to 70 decibels for all frequencies in both ears. The cotton wool is dipped in liquid paraffin and placed in the round window region. Representative cases with audiograms are given.

LEJEUNE and LEWIS, New Orleans, La.

DEAFNESS DUE TO ALLERGY. RAYMOND E. JORDAN, Laryngoscope **50**:152 (Feb.) 1950.

Allergy was found to be the cause of 85 per cent of 164 consecutive cases of chronic secretory otitis and chronic otitis media with effusion, and these conditions may eventually result in perforation of Sharpnell's membrane or in cholesteatoma formation. Wet postoperative fenestration or radical mastoidectomy cavities may be the result of allergy.

Allergy also produces inner ear disturbances, namely, Ménière's disease. Injections of histamine and other allergic treatment were effective for vertigo, but not for hearing loss. Allergic treatment of Ménière's disease without vertigo did show improvement of the hearing loss. In some cases of tinnitus there was also improvement by antiallergic routines.

HITSCHLER, Philadelphia.

THE TREATMENT OF CHRONIC PURULENT OTITIS MEDIA WITH GLYCERITE OF HYDROGEN PEROXIDE. WALTER E. OWEN, Laryngoscope **59**:1030 (Sept.) 1949.

Owen reports 130 cases of chronic purulent otitis media in which treatment was made with glycerite of hydrogen peroxide. This report follows a previous one on 29 cases. Limitations to the effectiveness of this treatment include the presence of attic perforations, cholesteatomas or concomitant eustachian tube infection. In 94 cases there was complete clearance of the chronic purulent otitis media with topical application. There was no improvement in one.

HITSCHLER, Philadelphia.

SURGICAL TREATMENT OF MÉNIÈRE'S DISEASE. FRANZ ALTMANN, Laryngoscope **59**:1045 (Oct.) 1949.

In order to evaluate results of treatment of Ménière's disease, strict criteria should be established for its diagnosis. Using such criteria, Altmann found that conservative medical treatment was, for the most part, unsatisfactory and that surgical procedures had to be resorted to.

The various types of operations, the theory behind them and the results obtained are well described.

HITSCHLER, Philadelphia.

CLINICAL RELIABILITY OF BONE CONDUCTION AUDIOMETRY. RAYMOND CARHART and CLAUDE HAYES, Laryngoscope **59**:1084 (Oct.) 1949.

Carhart and Hayes made a statistical investigation of the comparative reproducibility, i. e., test-retest reliability, of air conduction and bone conduction thresholds. There was no concern about the threshold itself being correct, rather only whether that threshold could be reliably reproduced.

The tests were made under clinical conditions. It was found, contrary to popular belief, that bone conduction measurements could be so reproduced; in fact, their accuracy was as good, or even slightly better, than those of air conduction.

HITSCHLER, Philadelphia.

IRRADIATION THERAPY OF FENESTRATION AND RADICAL MASTOIDECTOMY CAVITIES. G. O'NEIL PROUD and THEODORE E. WALSH, Laryngoscope **59**:1248 (Nov.) 1949.

It is well known that despite excellent surgical procedure and after-care, some fenestration and radical mastoidectomy cavities tend to fill up with granulation tissue. The standard nasopharyngeal applicator was used in 30 cases in which there was no response to other treatment. There were good results in a little more than half the cases.

HITSCHLER, Philadelphia.

THE EFFECTIVENESS OF DRAMAMINE IN RELIEVING THE VESTIBULAR REACTIONS FOLLOWING THE LABYRINTHINE FENESTRATION OPERATION. EDWARD H. CAMPBELL, Laryngoscope **59**:1261 (Nov.) 1949.

Dimenhydrinate (dramamine) was used in 28 patients after fenestration. Many other patients who had been treated in exactly the same way, except for use of the dimenhydrinate, were used as a control group. The patients treated with the dimenhydrinate showed much less vestibular symptoms, were able to eat, get up and be discharged from the hospital sooner. A detailed chart of the 28 cases is included.

HITSCHLER, Philadelphia.

AN ORIGINAL TECHNIC OF FENESTRATION FOR OTOSCLEROSIS. M. OMBREDANNE, Ann. d'oto-laryng. **66**:439 (Sept. 9) 1949.

The author describes his operative procedure of fenestration for otosclerosis. It consists of the total removal of the tympanic membrane and of the ossicles; these are replaced by a free graft placed over the opening of a double fenestration of the external semicircular canal and of the promontory.

The operation is shortened and simplified and is followed by complete and rapid healing. The auditory gain obtained by this procedure is presented and compares favorably, according to the author, with those obtained in the well done fenestration performed by the classical technics.

VIOLÉ, Los Angeles.

TUBERCULOUS OTITIS SUCCESSFULLY TREATED WITH *P*-AMINOSALICYLIC ACID IN TWO CASES. G. SMARS and S. G. KEMPE, Ann. d'oto-laryng. **66**:465 (Sept. 9) 1949.

Two patients with tuberculous otitis media (bacteriologically verified), with severe advanced generalized pulmonary and renal tuberculosis (pulmonary and intestinal in one and laryngeal in the other) and with very poor prognosis were treated with *p*-aminosalicylic acid by mouth. They made a startling recovery from the otitis, and there was a remarkable improvement in their general status. The two patients were free from bacilli for several months and were dismissed from the sanatorium with pronounced general amelioration of their condition.

VIOLÉ, Los Angeles.

NEURINOMA OF THE EIGHTH NERVE. RAUL BARRIOS, Rev. otorrinolaring. **9**:91 (Sept.) 1949.

Barrios presents a report on a patient with a neurinoma of the acoustic nerve. The symptoms were typical throughout the course of four years. At the time of operation a large neurofibroma of the acoustic nerve was found. This growth extended through the foramen magnum and down to the second cervical vertebra. Although the patient made a good surgical recovery, there was a recurrence of symptoms, owing to adhesions to vital structures, and he subsequently died.

PERSKY, Philadelphia.

COCHLEAR AND VESTIBULAR LESIONS IN ACUTE INTOXICATION WITH CARBON MONOXIDE. H. KOUMROUYAN, Pract. oto-rhino-laryng. **11**:307, 1949.

Koumrouyan presents four cases of carbon monoxide poisoning that produced definite pathological changes in the inner ear. He noted that there was an immediate bilateral deafness associated with tinnitus which usually involved the upper tones, principally c-4 to c-5. The lower tone limit was usually not involved. Perception by bone conduction was greater than

that by air conduction. When recovery occurred, it was within the first month following the poisoning. The audiograms presented varied types of results, but all indicated a disturbance of the upper tone limits.

The vestibular disturbances are acute and go hand in hand with the auditory disturbances. They usually present a vertigo of central origin, either spontaneous or induced. There is a nystagmus which may be either spontaneous or postural. There are anomalies of the movements of the reaction disproportionate between the caloric and rotational tests. Hyperexcitability or hypoexcitability may be present with either the caloric or the rotational test. The vertigo changes often resemble those found in certain cerebral disturbances. In addition to the above material, there are a number of sensory disturbances, such as anosmia.

Pathological studies revealed many changes, particularly in and about the cerebellum.

PERSKY, Philadelphia.

ENDAURAL SURGERY. A. MONTANDON, Prac. oto-rhino-laryng. **11**:347, 1949.

The author discusses endaural surgery and stresses the fact that this approach is not limited merely to the fenestration operation but can be utilized for many of the ordinary operations in the middle ear. He describes three types of incisions: (1) the triangular incision of Lempert, with the removal of the triangular flap; (2) a double incision of Shambaugh, which he reserves principally for the fenestration of the labyrinth, and (3) the pretympanic incision, which is reserved for minor operations on the tympanic cavity. The author believes that the use of the electric drill, irrigation-aspiration with isotonic sodium chloride solution and the binocular loupe is indispensable and offers the surgeon extreme precision, security and freedom of action in this delicate operation. The esthetic results are much superior to those of the retroauricular approach, but he stresses the fact that the endaural route is not to be used in the acute suppurations of the mastoid processes.

PERSKY, Philadelphia.

ACOUSTIC TRAUMA AND ITS EFFECT ON THE UPPER TONES IN GUINEA PIGS. F. KREJCI and H. BORNSCHEIN, Pract. oto-rhino-laryng. **12**:1, 1950.

The authors subjected 10 guinea pigs to extreme acoustic trauma and examined the inner ear both functionally and histologically. The functional examination was performed by means of cochlear potentials, while the histological examination was made by vital staining according to the Wittmaack technic. Functionally, it was shown that there was a dip at C-5 of 10 to 30 decibels immediately following the trauma, with a tendency toward becoming deeper and wider. Histologically these animals show a degeneration of the external hair cells and of Deiters' cells, extending from the end of the first coil up to the middle of the second coil. In two of the animals there was a complete disappearance of the organ of Corti.

PERSKY, Philadelphia.

ROLE OF THE OTOLITHS IN THE GENESIS OF THE VESTIBULOVEGETATIVE REFLEXES. J. HULK and H. E. HENKES, Pract. oto-rhino-laryng. **12**:65, 1950.

The authors attempted to evaluate the effect of the labyrinthine excitation in the vegetative nervous system. They used a method of measuring the diastolic retinal arterial pressure. By means of ordinary stimulation, either rotational or caloric, of the semicircular canals, they found that there is no apparent influence on the retinal vessels. However, to demonstrate their theory that the otoliths are actually responsible for the changes in the vegetative system, they constructed an apparatus in which the patient lies in a recumbent position, and in this position he can be either elevated or rotated, thereby exciting the otolith structures. They term this a "parallel balance" procedure. By this procedure they were able to show that the slightest excitation of the otolith could produce not only marked evidence of stimulation of the vegetative system (sweating, nausea, vomiting) but in a majority of the cases could also produce a clear alteration in the retinal arterial pressure. They conclude that the vestibulovegetative reflexes do exist but that the point of origin is the otolith and not the semicircular canal. This test may also have some significance in the study of seasickness and may present new theories about the origin of this phenomenon.

PERSKY, Philadelphia.

Pharynx

A PLEA FOR COMPLETE ADENOIDECTOMY. THOMAS F. FURLONG JR., J. Internat. Coll. Surgeons **13**:88 (Jan.) 1950.

The author discusses in moderate detail the technic of adenoidectomy, reemphasizing that each otolaryngologist should endeavor to perform it more completely by utilizing all the instruments that may be needed for this purpose. No attempt is made to change the present technic, for it is satisfactory. More efficient use of the adenotome, curet and punch, plus a recheck of the epipharynx digitally and visually, will accomplish a good result.

It is a known fact that the adenoidectomy is the last stage of the tonsillectomy and is therefore often hurried. The more efficient the adenoidectomy, other things being equal, the better the child's health, nutrition, respiratory habits and aural condition. All these points are basic in otolaryngology.

GORDON, Philadelphia.

THE USE OF RADIOGRAPHY IN THE DIAGNOSIS AND TREATMENT OF ADENOIDAL INVOLVEMENTS. JEAN MOULINARD, Ann. d'oto-laryng. **66**:455 (Sept. 9) 1949.

With the use of an aqueous solution of Oparenol (iodopyracet), 35 per cent, and Subtosan (a polyvinyl pyrrolidone preparation), 25 per cent, as a radiopaque solution, the adenoid mass is well delineated in the lateral or profile position.

Moulinard was able to distinguish four definite categories: (1) normal infantile vault; (2) first degree of adenoid hypertrophy; (3) second degree of adenoid hypertrophy, and (4) normal adult vault.

The author feels that the roentgenologic anatomic information has both a practical and scientific value.

VIOLÉ, Los Angeles.

Larynx

SURGICAL THERAPY OF CARCINOMA OF THE LARYNX. RÉTHI AUREL, J. Internat. Coll. Surgeons **13**:93 (Jan.) 1950.

Aurel is in favor of the surgical approach in laryngeal cancer. He discusses moderately three possible situations: one, in which the tumor is situated at the top of the epiglottis; two, in which cancer of the epiglottis has penetrated beyond the anterior commissure into the deep tissues of the vocal ligaments, and, three, in which cancer of the epiglottis extends above the anterior commissure.

The author believes that the suprahyoid and subhyoid pharyngotomy, as usually performed, "involve the risk that, owing to division of the muscles above or below the hyoid bone, energetic muscular traction after the operation may result in dehiscence of the wound." He presents a technic for avoidance of this and other complications, a technic which, in his hands, has given highly satisfactory results.

GORDON, Philadelphia.

Nose

ANTIBIOTICS AND SINUS INFECTIONS. F. W. DAVISON, Laryngoscope **50**:131 (Feb.) 1950.

Sinus infections resist penicillin therapy far more now than they did in 1945. Then, 80 per cent of the gram-positive cocci were sensitive to penicillin, now only 12 per cent are. This situation is probably due to the widespread and inadequate use of penicillin therapy. Other studies showed that the blood level of penicillin now has to be 15 times as high as it was in 1946 in order to have the same effectiveness. Only intramuscular injections can give sufficiently high blood levels, and sometimes 400,000 units every three hours is necessary. The use of penicillin in nose drops, aerosol inhalations, by injection into antrums or by displacement has been abandoned.

Streptomycin is an effective antibiotic but may give toxic reactions. Aureomycin can be given in 250 mg. doses by mouth every six hours with good results. Chloromycetin is not as effective as aureomycin.

HITSCHLER, Philadelphia.

CARDIOVASCULAR EPISTAXIS AND THE NASO-NASOPHARYNGEAL PLEXUS. GEORGE H. WOODRUFF, Laryngoscope **59**:1238 (Nov.) 1949.

Cardiovascular epistaxis is compared to the common nosebleed from Kiesselbach's area. It occurs in older people, usually those with high blood pressure.

The area involved may be anywhere in the nose, the posterior lateral wall of the inferior meatus being the commonest site in the series of cases presented. In this area there was observed to be a vascular plexus. Disease of this plexus might account for the hemorrhage. Control in this area is best effected by tamponage of the inferior meatus, but ligation of the external carotid artery may be necessary and should not be delayed too long if other measures fail.

HITSCHLER, Philadelphia.

A FATAL NASAL HEMORRHAGE OF RARE OCCURRENCE. PAUL RASQUIN, Ann. d'oto-laryng. **66**:445 (Sept. 9) 1949.

The care of epistaxis is usually uneventful, although in some cases ligation of the internal maxillary artery by the transantral route, as advocated by Escat, may be indicated. In Rasquin's case there existed a juxtastyloidal aneurysm of the internal carotid artery, rupturing into the nasal vault. The author discusses the means that should have been used to control the nasal hemorrhage and advises that in similar instances the common carotid artery should be ligated.

VIOLÉ, Los Angeles.

Miscellaneous

INJECTIONS OF HYPERTONIC SOLUTION AND DISTILLED WATER IN THE TREATMENT OF VERTIGO. R. MAYOUX and L. PAUFIQUE, Ann. d'oto-laryng. **66**:450 (Sept. 9) 1949.

The authors maintain that intravenous injections of 10 cc. of hypertonic saline solution or distilled water considerably relieve 90 per cent of instances of vertigo which are not of neurological origin. The tension of the central artery of the retina is observed. When the tension is elevated, five to 10 injections of hypertonic solution are used, and if it is lowered distilled water is used. If the hypertonic solution fails, then the distilled water is used, and vice versa.

VIOLÉ, Los Angeles.

CLINICAL AND THERAPEUTIC EXPERIENCES WITH INTRAVENOUS USE OF HISTAMINE. MARIO RIUS, An. oto-rino-laringolog. de Uruguay **19**:55, 1949.

Rius presents a series of seven patients who complained of tinnitus, deafness and dizziness. He made a diagnosis of hydrops of the labyrinth. He treated these patients with histamine solution administered intravenously, according to the technic of Sheldon and Horton. The solution was administered at the rate of 14 to 20 drops per minute. He achieved a 50 per cent rate of cure in his cases. He stressed the fact that improvement in the deafness and tinnitus occurred most in those cases in which symptoms lasted less than six months. However, when the symptoms are present for more than six months, the chances for degeneration of the neuroepithelium within the labyrinth are increased and prognosis is more unfavorable. The tinnitus and vertigo improved in every case when the diagnosis was correct.

PERSKY, Philadelphia.

HEADACHES. A. HECTOR SERANI, Rev. Otorrinolaring. **10**:14 (March) 1950.

The author discusses headaches from the internist's standpoint and outlines a number of conditions that may be responsible either directly or indirectly for these headaches. He mentions chronic cholecystitis and constipation, which are of questionable relationship. Alcohol in itself is not considered an important factor; however, conditions associated with an excessive intake of alcohol are more directly involved, such as excessive use of tobacco, excessive eating, insufficient rest and faulty elimination. The author feels that the psychosomatic structure of the patient is an important factor. In his experience, 50 per cent of headaches are of psychogenic origin. A hypertensive condition plays an important role. Ophthalmological disturbances occur in a very small percentage of the cases. Endocrinologic dysfunction is an important factor. Otorhinological and neurological conditions should be ruled out as possible sources.

PERSKY, Philadelphia.

Special Reports

HEARING AIDS ACCEPTED BY THE COUNCIL ON PHYSICAL MEDICINE AND REHABILITATION OF THE AMERICAN MEDICAL ASSOCIATION

As of Jan. 1, 1951

Aurex Model F
Aurex Model H
Mfr., Aurex Corporation
1117 N. Franklin St.
Chicago 10

Beltone Mono-Pac
Beltone Harmony Mono-Pac
Beltone Symphonette
Beltone Mono-Pac Model M
Mfr., Beltone Hearing Aid Company
1450 W. 19th St.
Chicago 8

Cleartone Model 500
Cleartone Regency Model
Mfr., American Sound Products, Inc.
2454 S. Michigan Ave.
Chicago 16

Dysonic Model 1
Mfr., Dynamic Hearing Aids, Inc.
1042 Atlantic Ave.
Brooklyn 16

Electroear Model C
Mfr., American Earphone Co., Inc.
10 E. 43rd St.
New York 17

Gem Model V-35
Gem Model V-60
Mfr., The Gem Ear Phone Co., Inc.
50 W. 29th St.
New York 1

Maico Atomeer
Maico UE Atomeer
Maico Quiet Ear Models G and H
Mfr., The Maico Company, Inc.
21 N. 3rd St.
Minneapolis 1

Mears Aurophone Model 200
1947-Mears Aurophone Model 98
Mfr., Mears Radio Hearing Device Corp.
1 W. 34th St.
New York 1

Micronic Model 101 (Magnetic Receiver)
Micronic Model 303
Mfr., Micronic Company
727 Atlantic Ave.
Boston 11
(See Silver Micronic)

Microtone T-3 Audiomatic
Microtone T-4 Audiomatic
Microtone T-5 Audiomatic
Microtone Classic Model T9
Microtone Model 45
Mfr., The Microtone Company
Ford Parkway on Mississippi
St. Paul 1

National Cub Model (C)
National Standard Model (T)
National Star Model (S)
National Ultrathin Model 504
National Vanity Model 506
Mfr., National Hearing Aid Laboratories
815 S. Hill St.
Los Angeles 14

Otarion Model E-1
Otarion Model E-1S
Otarion Model E-2
Otarion Model E-4
Otarion Models F-1 and F-2
Mfr., Otarion, Inc.
159 N. Dearborn St.
Chicago 1

Paravox Models VH and VL
(Standard)
Paravox Model XT ('Xtra-Thin)
Paravox Model XTS ('Xtra-Thin)
Paravox Model Y (YM, YC and YC-7)
(Veri-small)
Mfr., Paravox, Inc.
2056 E. 4th St.
Cleveland 15

Radioear Permo-Magnetic Multipower
Radioear Permo-Magnetic Uniphone
Radioear All-Magnetic Model 55

Radioear Model 62 Starlet
Mfr., E. A. Myers & Sons
306-308 Beverly Road
Mt. Lebanon
Pittsburgh 16

Silver Micronic (Magnetic and Crystal)
Models 202M and 202C
Mfr., Micronic Company
727 Atlantic Ave.
Boston 11
(See Micronic)

Silvertone Model 103BM
Mfr., National Hearing Aid Laboratories
815 S. Hill St.
Los Angeles 14

Distr., Sears, Roebuck & Company
925 S. Homan Ave.
Chicago 7

Silvertone Model M-35
Mfr., Micronic Company
727 Atlantic Ave.
Boston 11

Distr., Sears, Roebuck & Company
925 S. Homan Ave.
Chicago 7

Silvertone Model P-15
Mfr., W. E. Johnston Mfg. Company
708 W. 40th St.
Minneapolis 8

Distr., Sears, Roebuck & Company
925 S. Homan Ave.
Chicago 7

Solo-Pak Model 99
Mfr., Solo-Pak Electronics Corp.
Linden St.
Reading, Mass.

Sonotone Model 600
Sonotone Model 700
Sonotone Model 900
Sonotone Models 910 and 920
Sonotone Model 925
Mfr., Sonotone Corporation
Elmsford, N. Y.

Super-Fonic Hearing Aid
Mfr., American Sound Products, Inc.
2454 S. Michigan Ave.
Chicago 16

Televox Model E
Mfr., Televox Mfg. Company
1307 Sansom St.
Philadelphia 7

Telex Model 22
Telex Model 97
Telex Model 99
Telex Model 200
Telex Model 1700
Mfr., Telex, Inc.
Telex Park
Minneapolis 1

Tonemaster Model Royal
Mfr., Tonemaster, Inc.
400 S. Washington St.
Peoria 2, Ill.

Trimm Vacuum Tube Model 300
Mfr., Trimm Distributors, Inc.
400 Lake St.
(P. O. Box 489)
Libertyville, Ill.

Unex Model A
Unex Midget Model 95
Unex Midget Model 110
Mfr., Nichols & Clark
Hathorne, Mass.

Vacolite Model J
Mfr., Vacolite Company
3003 N. Henderson St.
Dallas 6, Tex.

Western Electric Model 63
Western Electric Model 64
Western Electric Models 65 and 66
Mfr., Western Electric Co., Inc.
120 Broadway
New York 5

Zenith Model 75
Zenith Miniature 75
Mfr., Zenith Radio Corporation
6001 W. Dickens Ave.
Chicago 39

(All the accepted hearing devices have vacuum tubes.)

Accepted hearing aids more than five years old have been omitted from this list for brevity.

TABLE HEARING AIDS

Aurex (Semi-Portable)
Mfr., Aurex Corporation
1117 N. Franklin St.
Chicago 10

Precision Table Hearing Aid
Mfr., Precision Hearing Aids
5157 W. Grand Ave.
Chicago 39

Sonotone Professional Table Set Model 50
Mfr., Sonotone Corporation
Elmsford, N. Y.

SPECIAL NOTICE

For the general information of indexers, catalogers and library personnel with reference to the listing of the new title of this journal, we advise that the *Quarterly Cumulative Index Medicus* policy be followed. The *Quarterly Cumulative Index Medicus* with its volume 49 (January-June 1951) will list this journal under the new title, so that the letters A. M. A. will be included as an integral part of the title. For the completion of volume 48 (July-December 1950) the *Quarterly Cumulative Index Medicus* will continue to use the old title, without adding the designation A. M. A.

Book Reviews

Office Treatment of the Nose, Throat and Ear. Third edition. By Abraham R. Hollender, M.Sc., M.D., Professor of Otolaryngology, Emeritus, University of Illinois College of Medicine, and Attending Otolaryngologist, St. Francis Hospital and Mount Sinai Hospital, Miami Beach, Fla. Price, $7.50. Pp. 636, with 150 illustrations. The Year Book Publishers, Inc., 200 E. Illinois St., Chicago, 1950.

As one of the general practice manuals of the publishers, this new edition continues to express the modern concepts of treatment of otolaryngological diseases that may be performed in the office. The author has taken the opportunity to rewrite the chapter on nutritional management, to make changes dealing with physical medicine and to add a new chapter on the psychosomatic approach to otolaryngology.

Section one of the book contains a general survey of the field, and section two discusses in sequence diseases of the nose, paranasal sinuses, mouth and pharynx, larynx, ear and neurological disorders. A subject index and a name index follow.

In general, the quality of the text is good. However, in passing, certain observations were made: The treatment of cocaine reaction of the immediate type is not of modern concepts, and neither is the discussion of the treatment of gingivitis. The section covering the diseases of the salivary glands seems too meager. Discussion of the newer technics of radium treatment of the nasal pharynx is somewhat ambiguous, as is the discussion of the pharyngeal symptoms of bulbar paralysis. Mention of the newer antibiotics is conspicuous by its absence, as is the discussion of the fenestration operation in regard to otosclerosis, to mention but a few items that need clarification in an otherwise quite good book.

Diagnosis and Treatment of Tumors of the Head and Neck. By Grant E. Ward, M.D., D.Sc., and James W. Hendrick, M.D., M.S., from the Departments of Surgery of the University of Maryland School of Medicine, The Johns Hopkins University School of Medicine and the Oncology Clinic of the University Hospital. Price, $15. Pp. 845, with 629 illustrations and 9 color plates. Williams & Wilkins Company, Mount Royal and Guilford Aves., Baltimore 2, 1950.

The present volume has been written by authors well qualified to discuss the diagnosis and treatment of those tumors of the head and neck which are becoming increasingly prominent in the practice of otolaryngology. Unfortunately, it is believed that the experience of some of the collaborators has not been extensive enough to maintain the general tone of the book on an equally high plane.

The text is rather well written, and the contents of the book are arranged in the following sections: introduction; early development of the head and neck; benign tumors and premalignant lesions of the skin; malignant neoplasms of the skin; benign tumors and premalignant tumors of the lips; cancer of the lips; benign tumors of the oral cavity; malignant conditions of the oral cavity; cancer of the tongue; tumors of the jaws; salivary tissue tumors; tumors of the tonsils, pharynx and base of the tongue, paranasal sinuses, nasal mucous membrane, eye and adnexa, ear and larynx; tumors primary in the neck and in the lymph tissues; metastatic tumors of the neck; tumors of the skull, and rehabilitation. Each chapter has its own bibliography; some, however, do not include the more recent publications. The index is adequate.

Note might be made of the lack of discussion of mucoceles of the paranasal sinuses, and in the discussion of pseudotumors of the orbit no mention was made of the role of the endocrine glands. The discussion of tumors of the larynx, though well written, seems too brief, and fistula of the thyroglossal tract is pictured as a pathological lesion of the lateral pharyngeal wall in a mislabeling of one of the figures.

However, as a guide to and as a discussion of all types of neoplasms of the head and neck (excluding the brain and the central nervous system), this book is recommended for the viewpoints it presents.

The Comparative Anatomy and Physiology of the Larynx. By V. E. Negus, M.S., F.R.C.S., Surgeon to the Ear, Nose and Throat Department, King's College Hospital, London. With a foreword by Sir Arthur Keith. Price, $6.50. Pp. 230, with illustrations. Grune & Stratton, Inc., 381 Fourth Ave., New York 16, 1949.

It was my pleasure to review that monumental work "The Mechanism of the Larynx" on its appearance in 1940, although the first edition had appeared in England in 1928. Much in demand, the book was hard to "come by," as our British cousins put it. At that time everyone marveled that a person could live long enough to put so much original work in such an enormous tome, for the contents were replete with original illustrations of the "lower order of animals" from the sea urchin up (and down)!

Negus visited here several years after his work became known in America. It was his intention to revise the material and bring out a new edition, but World War II intervened. The present book is a sort of compromise, a condensation of the earlier and larger work, and is presented under a new title. A number of new illustrations have been added, and various animals have been represented anatomically as a whole rather than in part. Those chapters which deal more directly with the structure and development of the human larynx have been revised and enlarged. As always, Negus' anatomic studies are for the purpose of understanding function better. The point is made that the larynx originally protected the lower airways and that voice was a late function. Many animals seen today have an excellent looking larynx, and yet they do not speak or sing. These acts stem from the brain. The higher the cerebral development, the better effect has the sounds which come out of the larynx. This is not an invariable rule, but it is a good one.

Your Deaf Child. By Helmer R. Myklebust. Price, $2.50. Pp. 132, with 17 illustrations. Charles C Thomas, Publisher, 301-327 E. Lawrence Ave., Springfield, Ill., 1950.

"Your Deaf Child," a guide for parents, is precisely what the title implies; it is well directed toward the parents of the deaf child. The book is simply written, with clarity, and can be well understood by most parents, regardless of educational background. The first few chapters discuss the handicap of deafness under the following titles: "What Deafness Means to You," "Causes and Types of Deafness," "Your Attitudes and What They Mean." The next four chapters discuss the numerous difficulties encountered in bringing up deaf children. Many practical suggestions are offered for the adjustment of the parents and the child. The last chapter is devoted to reading references and includes organizations interested in the hard of hearing and deaf child, as well as an excellent directory of schools for such children.

The book gives excellent advice and insight to parents for the better understanding of the problems surrounding them. It presents an optimistic note of the happy possibilities in such a situation and is very highly recommended.

Directory of Otolaryngological Societies *

NATIONAL

American Medical Association, Scientific Assembly, Section on Laryngology, Otology and Rhinology

Chairman: Dr. J. Milton Robb, 1553 Woodward Ave., Detroit 26.
Secretary: Dr. Sam H. Sanders, 1089 Madison Ave., Memphis 3, Tenn.
Place: Atlantic City, N. J. Time: June 13-15, 1951.

American Academy of Ophthalmology and Otolaryngology

President: Dr. J. Mackenzie Brown, 1136 W. 6th St., Los Angeles 14.
Executive Secretary-Treasurer: Dr. William L. Benedict, 100-1st Ave. Bldg., Rochester, Minn.

American Board of Otolaryngology

Secretary: Dr. Dean M. Lierle, University Hospitals, Iowa City.
Place: Hotel Biltmore, New York. Time: Jan. 8-11, 1951.
The Roanoke Hotel, Richmond, Va. Time: May 1-4, 1951.

American Broncho-Esophagological Association

President: Dr. Chevalier L. Jackson, 3401 N. Broad St., Philadelphia 40.
Secretary: Dr. Edwin N. Broyles, 1100 N. Charles St., Baltimore 1.
Place: White Sulphur Springs, W. Va. Time: May 7 and 8, 1951 (p. m.).

American Laryngological Association

President: Dr. Gordon B. New, 102 2d Ave., S.W., Rochester, Minn.
Secretary: Dr. Louis H. Clerf, 128 So. 10th St., Philadelphia 7.
Place: White Sulphur Springs, W. Va. Time: May 9-10, 1951.

American Laryngological, Rhinological and Otological Society, Inc.

President: Dr. Louis H. Clerf, 128 So. 10th St., Philadelphia 7.
Secretary: Dr. C. Stewart Nash, 708 Medical Arts Bldg., Rochester 7, N. Y.
Place: White Sulphur Springs, W. Va. Time: May 6-8, 1951 (a. m.).

SECTIONS:

Eastern.—Chairman: Dr. Harry P. Schenck, 326 So. 19th St., Philadelphia 3.
Place: Philadelphia. Time: Jan. 12, 1951.
Southern.—Chairman: Dr. Charles C. Grace, 145 King St., St. Augustine, Fla.
Place: Miami, Fla. Time: Jan. 17, 1951.
Middle.—Chairman: Dr. Clarence W. Engler, 2323 Prospect Ave., Cleveland.
Place: Cleveland. Time: Jan. 15, 1951.
Western.—Chairman: Dr. Lewis F. Morrison, 490 Post St., San Francisco.
Place: San Francisco. Time: Jan. 27-28, 1951.

American Otological Society

President: Dr. Kenneth M. Day, 121 University Place, Pittsburgh.
Secretary: Dr. John R. Lindsay, 950 E. 59th St., Chicago.
Place: White Sulphur Springs, W. Va. Time: May 11-12, 1951.

American Otorhinologic Society for the Advancement of Plastic and Reconstructive Surgery, Inc.

President: Dr. Norman N. Smith, 291 Whitney Ave., New Haven 11, Conn.
Secretary: Dr. Joseph G. Gilbert, 111 E. 61st St., New York 21.

American Society of Ophthalmologic and Otolaryngologic Allergy

President: Dr. George E. Shambaugh Jr., 55 E. Washington St., Chicago.
Secretary-Treasurer: Dr. Joseph Hampsey, 806 May Bldg., Pittsburgh 22.

* Secretaries of societies are requested to furnish the information necessary to keep this list up to date.

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"Psychosomatic Aspects of Hearing Defects: Part I"

To assist your understanding of the problems confronting your hard-of-hearing patients this booklet has been mailed to you. It discusses Misconceptions about the Hard-of-Hearing, Extent of Hearing Defects, Causes and Prevention of Hearing Defects, Relation of Hearing Defects to Speech, Effect of Hearing Loss on Mental Processes, and Effects of Hearing Defects on Personality. If you have not received your copy, or desire an additional one, just check the coupon or mail a post-card request.

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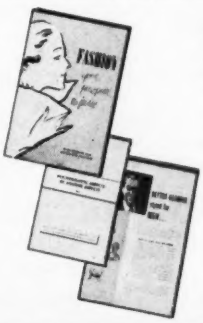

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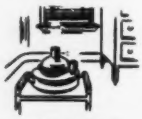

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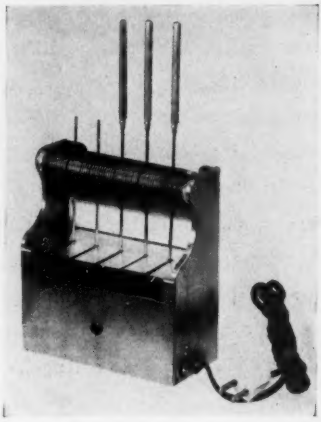

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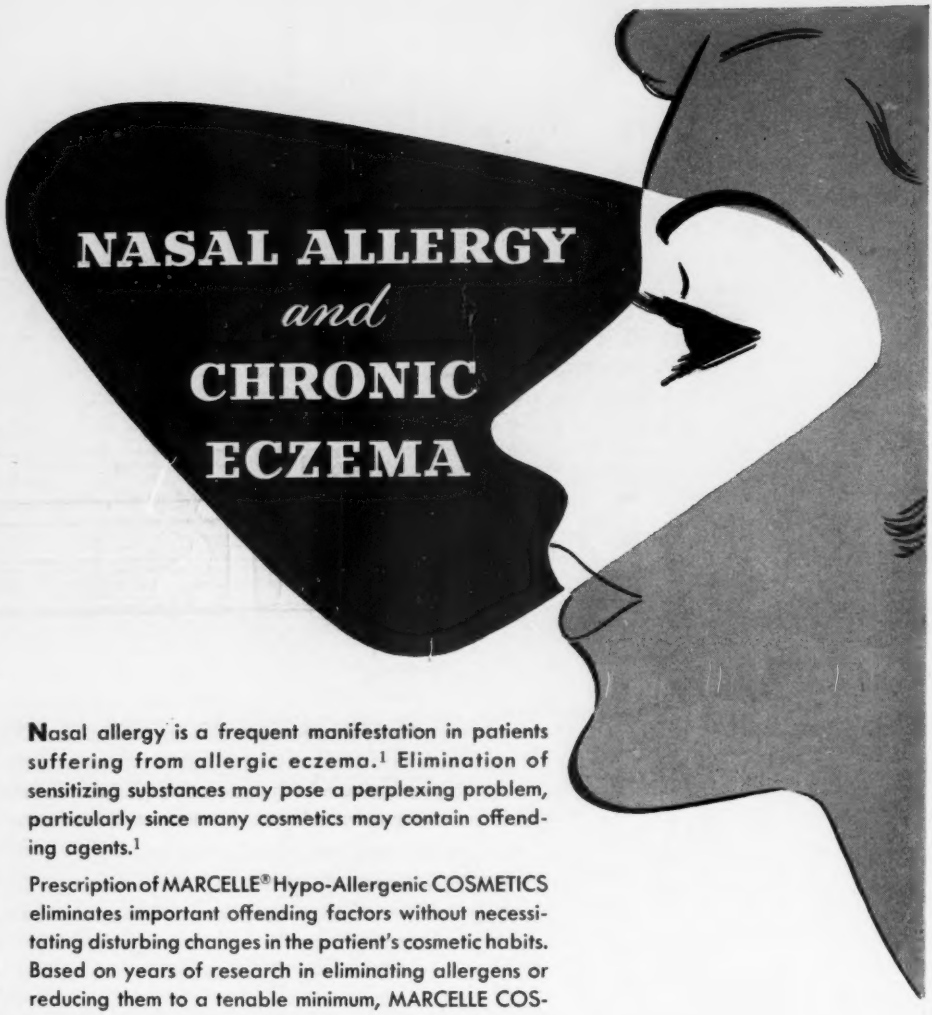

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1. Waldbott, G. L.: Management of Allergic Eczema. Am. Pract. 4:59-63 (Oct.), 1949.

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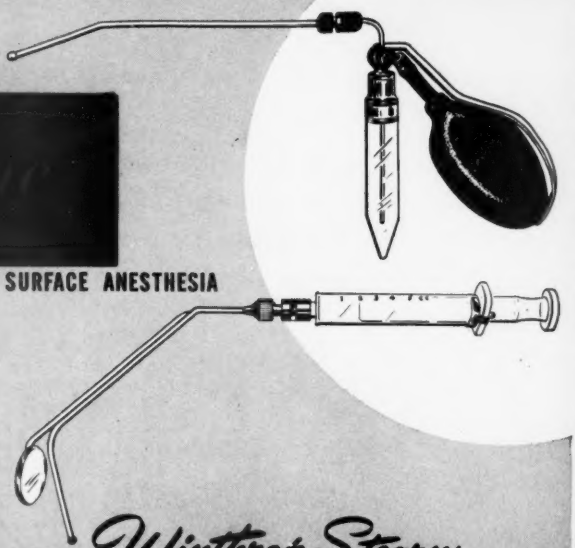

1. Carabelli, A.: *Diseases of the Chest*, 15:532, May, 1949.
2. George P. Pilling & Sons, Company, 3451 Walnut Street, Philadelphia 4, Pa.

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